

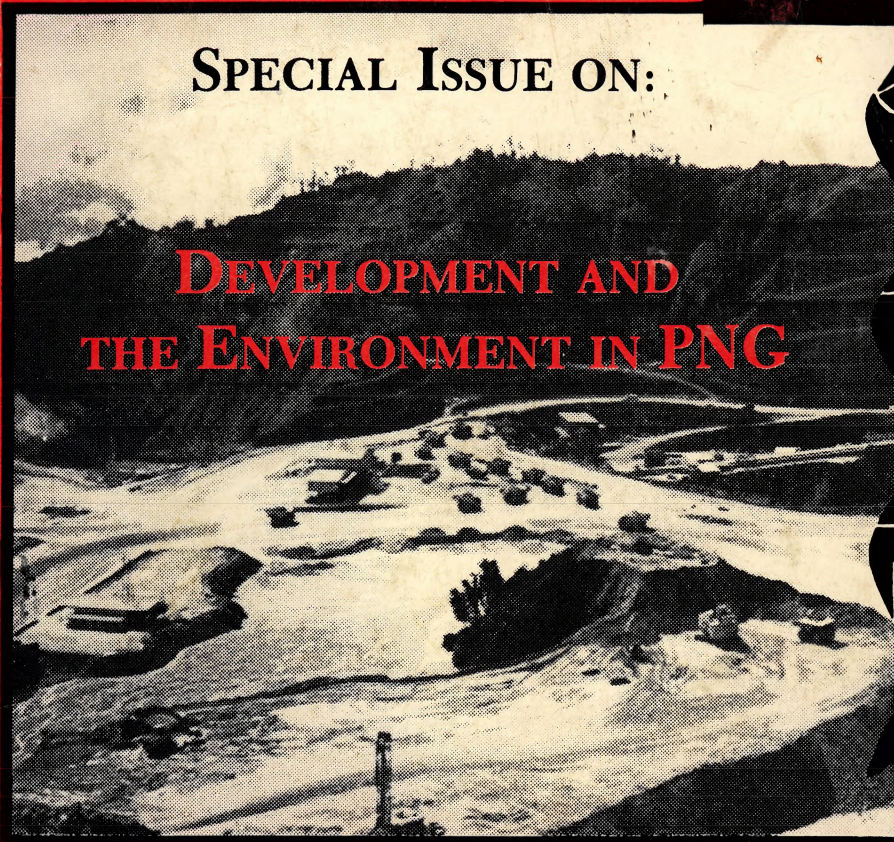
CATALYST

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SPECIAL ISSUE ON:

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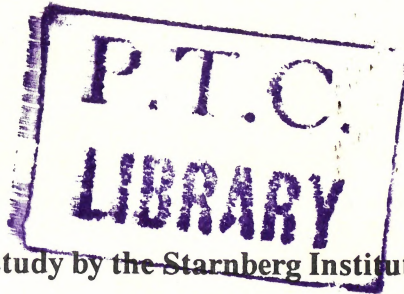
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Development and The Environment

Economic-Ecological Development in Papua New Guinea



A study by the ~~Starnberg~~ Institute

*Commissioned by the Department of World Mission
of the Evangelical Lutheran Church in Bavaria (Germany)*

October 1991

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The Starnberg Institute is an independent social science research organisation based in Bavaria, Federal Germany. Its principal concern is to carry out research on the inter-relationship between global, political, economic, ecological and social development. The Institute is a successor body to the Max-Planck Institute located in Starnberg, originally established and co-directed by the philosopher and physicist Carl Friedrich von Weizsaecker. Among the numerous sponsors of projects carried out by the Starnberg Institute have been the Max Planck Society, the German Research Association, the Volkswagen Foundation, the Evangelical Church in Germany, the United Nations University and the International Labour Office.

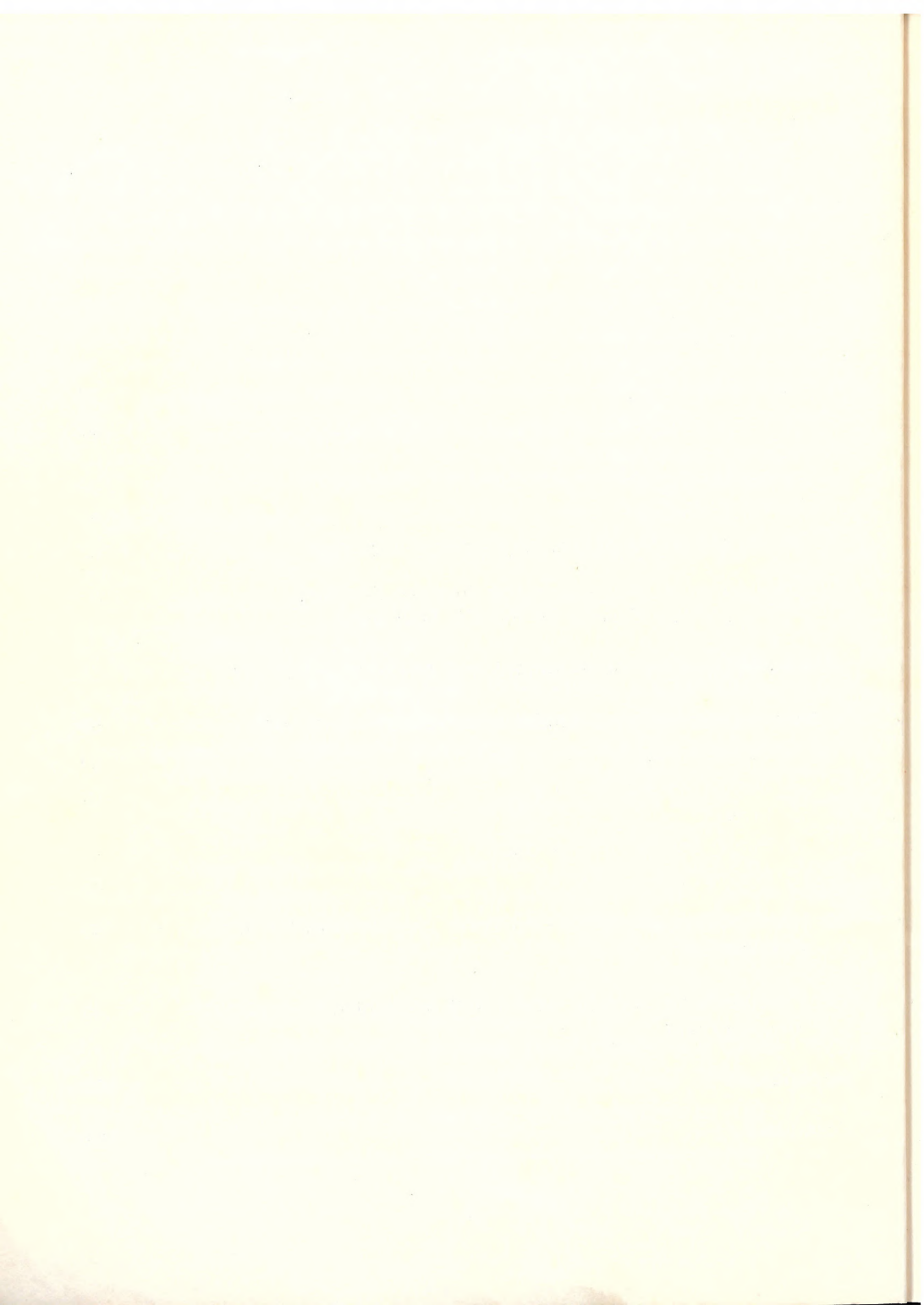
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FOREWORD

Papua New Guinea is rich in natural resources compared with other countries in the Pacific region. This wealth, however, seen merely as economic wealth, is inseparably connected with our land, our rivers, our forests and our seas, as well as with our people and communal life.

All of these are under threat in a way not seen by most economic experts. But our current pattern of development shows most pointedly how environmental issues are closely linked with social and political tensions.

Two world conferences with a focus on the protection of creation, were held in the last two years in the Asian-Pacific region by the World Council of Churches (WCC). In March 1990 a World Convocation on 'Justice, Peace and Integrity of Creation' was held in Seoul, South Korea.

In the preparatory documents for this, it was stated: 'The destruction of nature under the burden of greed and carelessness raises a question mark over the survival of life on our globe: in such a time, God is calling the churches to make known and work for the integrity of creation'. (FORUM 8)

The PAPUA NEW GUINEA COUNCIL OF CHURCHES (PNGCC) is therefore very grateful, that The MELANESIAN INSTITUTE is able to publish this study on the 'Economic-Ecological Development in Papua New Guinea'. We recommend it to the Churches for study and discussion. The study was conducted by the Starnberg Institute (Germany) and financed by the Lutheran and Catholic Churches in Germany.

This document explains with facts and figures, the disastrous manner in which our economy and ecology are tied up with the whole world economy, especially by the exploitation of our raw-materials. This crucial topic of the world economic order was high on the agenda of the second WCC-Conference in our region, the WCC Seventh Assembly, held in Canberra early this year.

In Section I, 'Giver of Life - Sustain our Creation', a whole chapter was dedicated to the theme 'Towards an Ethic of Economy and Ecology'.

The Assembly declared: 'It is not production and consumption that sustain our earth but rather the ecological systems that have to support human life. There

exists an intimate and unbreakable relationship between economy and ecology'. (No. 18)

'To this valid critique of economic order we have to add the totally irresponsible exploitation of the created world, resulting in a horrific degradation of the planet earth'. (No. 25)

Reform of the economic order in the past never came automatically, but always through contradiction, opposition and social struggle. We are aware that now more than ever the market economy is in need of reform towards a realisation of social justice and ecologically responsible human behaviour'. (No. 26)

Similarly, the searching details of this study are calling for reform.

At Independence we anchored the protection of nature in our Constitution. But in practice have we abandoned this path in favour of an unscrupulous exploitation of our national and natural resources?

The 'Eight Points' of the Government's White Paper in 1980 proposed a programme of economic and social development based on self-reliance and local production, social justice and equal distribution of economic benefits. We have to realise that we are no longer following this guidelines.

This 'christian' nation, with its meaningful traditional spiritual heritage could easily follow what the Canberra Assembly declared:

'The divine presence of the Spirit in Creation binds us human beings together with all created life. We are accountable before God in and to the community of life, an accountability which has been imaged in various ways: as servants, stewards and trustees, as tillers and keepers, as priests of creation, as nurturers, as co-creators. This requires attitudes of compassion and humility, respect and reverence'. (No. 2)

We hope that this profound study will stimulate a broad and intensive discussion on the economic and ecological future of our nation, for the betterment of its people of to-day and of following generations.

*Rev. Leva Kila Pat,
General Secretary,
PNG Council of Churches*

SUMMARY

CHAPTER I: Aims, strategies and processes of development in PNG

Papua New Guinea would appear to be a land of abundant 'developmental potential', naturally endowed with luxuriant forests, fertile soils, and mineral resources. The political system of the country represents a remarkable synthesis of traditional democratic structures and modern democratic institutions. Nevertheless, Papua New Guinea is in crisis. (p.13)

The present study examines whether these expectations have been fulfilled. Given the enormous scale of the Ok Tedi project and the fact that in many respects it is representative of other large-scale projects, our analysis of Ok Tedi project is also intended to elucidate the overall developmental path adopted by Papua New Guinea. (p.19)

CHAPTER II: The Ok Tedi Project

Although the mine is currently producing at maximum output and costs and revenues appear to be developing very favourably, no distribution of profits has been promised to the shareholders and to the government before 1992. Declared profits for 1988 of Kina 20.7 million and for 1989 of 24.2 million have both been on the low side. Since production began in 1984, the state has received no income from its shares in the mine. Any declared profits in individual years since 1984 have been used for investment or debt-service. (p.25)

The original plans envisaged much higher revenues than can now evidently be expected. In 1982 a maximum possible tax take from Ok Tedi of US\$ 2,900 million was estimated. (p.26)

In order to supply the mine and transport copper concentrate, the Ok Tedi region was endowed with a very impressive infrastructure. Almost

all these facilities are intended exclusively to meet the needs of the mine and its employees. Only very limited use is granted to the local residents not working for the mine and the provincial government. (pp.27-28)

The mine currently provides employment for 3,200 workers. Some 85% of the workforce are nationals, 15%, around 460, predominantly managerial employees are from abroad. However, the number of jobs available for work-seekers from Western Province is only by 30%. (p.32)

It is well-known that mining operations at Ok Tedi have imposed massive burdens on the environment. What is controversial is whether these burdens will lead to permanent environmental damage and whether they represent an enduring threat to the natural foundations of human life. Currently some 70,000 tonnes of ore are mined and processed into copper concentrate. The waste rock and tailings which result from the production, totalling 150,000 tonnes a day, are either discharged directly into the Ok Tedi or dumped and washed into the river by rain. (p.33) (Suppose this daily waste of 150,000 tonnes would be loaded on the used mining-trucks of 25 tonne capacity each, 6,000 of those trucks would be needed. These trucks lined up along the highway would occupy a distance from Goroka to the junction of Lae-Madang, Watarais. An explanation by the publisher.)

The known effects on the environment so far have been very profound. Not only is the water in the two rivers, the lagoons and the Fly River delta under strain, but the sedimentary deposits also impose a burden on the land in the river regions. Copper in solution and other heavy metals can make the water in both rivers toxic to fish and undrinkable for humans. (p.33)

The current and enduring damages to the environment, are not without social effects. The damage to water, the reduction in fish stocks, the deposition of mining sediment, including agricultural land, all threaten either to impair or destroy the natural foundations of life of those people

living in the subsistence economy. More people will be compelled to migrate to urban areas to swell the number of those lacking employment or an income. (p.34)

CHAPTER III: Environmental damage by the Ok Tedi Mining Limited

The low-lying rain-forest is subject to considerable flooding. The swamps bordering the Middle Fly were typically 16 km across before mining began. According to the company, over time the river bed will rise by 2-3 metres as a result of sediments originating in the open-cast mining operations. This will considerably enlarge the regularly-flooded area adjacent to the river. (pp.44-47)

Deposition of sediment, which contains between 1g and 5g particulate copper per kg sediment, will increase in this flooded area. Subsequently the barely one centimetre deep humus layer in the rain-forest in this area will soon exhibit a similarly high copper concentration. Dying forests are not the only consequence of the intense stress on the river caused by this sediment. As a consequence, fish stocks in the Fly River are not only being directly reduced by the extremely concentrated sharp-edged sediment, but also indirectly through the onset of forest-death, with corresponding loss of food. (pp.44-47)

There are good grounds for fearing that mining operations at Ok Tedi will initiate long term, that is centuries of ecological, cultural, health and economic damage far exceeding the short term economic gains. The Fly River has begun to show signs of serious and lasting environmental damage, and the sea-water of the Gulf of Papua is heavily polluted. (p.53)

CHAPTER IV: Implications for development and environment policy

The Ok Tedi project appears to have fallen far short of fulfilling the hopes originally pinned on it. Should it prove impossible to adequately eliminate the cost element of the extremely high burden on the environment and secure an appropriate participation for the country in economic

gains from the project, then only one recommendation can be plausible: that mining operations should be stopped without delay, and the project wound up in an orderly fashion. (p.57)

CHAPTER V: PNG's Developmental model in crisis

By the late-1980s, what had appeared for some fifteen years as the successful strategy of achieving sustained economic growth through mineral and agricultural raw-material production and export ran into a crisis. PNG's Gross Domestic Product fell in 1989 and during the first half of 1990. Gross Investment is also falling. Employment in the 'formal sector' has declined. Agricultural output is stagnant. The budget deficit has increased, and foreign indebtedness has grown. (p.63)

The 'Bougainville Crisis' is not some secondary symptom of the process of development in PNG: it is a direct expression of the crisis of the model which has been pursued since national independence. (p.64)

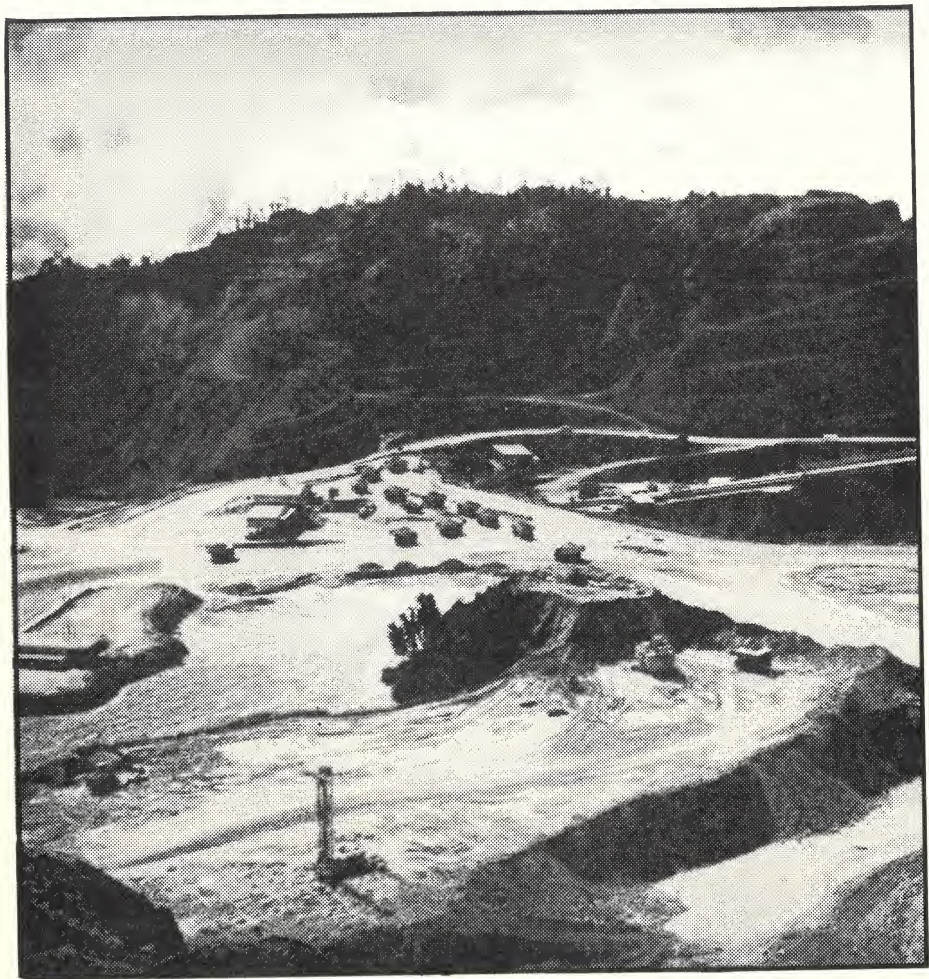
The attempt to achieve development through raw-material production for the world-market has generated a series of deleterious developments which threaten to increase in scale if the model continues to be pursued. (p.86)

CHAPTER VII: Prospects for socially useful and ecologically sustainable development

Papua New Guinea is one of the first, and one of the few countries in which the protection of the environment is constitutionally anchored. And the environmental task set by the Constitution is clear. (p.96)

What can be done to indicate the steps and strategic decisions necessary for a form of economic and environmental development in PNG which would move the country closer to its declared developmental aims? (p.98)

The conditions for the implementation of policies rooted in the economic and environmental tasks set out in PNG's Constitution are by no means inauspicious. But democratic structures are still intact, even if under threat. The country still has control over a large measure of economic independence, mainly by virtue of the fact that 85% of the population are still able to provide for themselves through subsistence production. The rain-forest is still largely undamaged and environmental problems are still within bounds. The country can still make the most of its natural riches. (p.101)



All the Chapters of this research were written by Professor Otto Kreye except Chapter III by Professor Lutz Castell from the Institute for Environmental Damage and Research.

Chapter I

Aims, strategies and processes of development in Papua New Guinea

Naturally endowed with luxuriant forests, fertile soil, and mineral resources, Papua New Guinea would appear to be a land of abundant 'developmental potential'. The political system of the country, which became independent in 1975, represents a remarkable synthesis of traditional democratic structures, for example clan-based common ownership of land, and modern democratic institutions, such as a federally-structured parliamentary system. Nevertheless, Papua New Guinea is in crisis.

One expression of this crisis is the prolonged conflict between the insurrectionary independence movement in the North Solomons Province (Bougainville) and the central government, a conflict which has not only created massive economic disruption but also now threatens the political unity of the country. Panguna Copper Mine on Bougainville, the largest copper mine in the country, and one of the largest in the world, has been closed down and production in the island's plantations has also been brought to a virtual standstill. For the central government, this has meant the drying up of a major source of revenue and foreign exchange. As a consequence drastic cuts have been made in public expenditure. On Bougainville itself, hunger and sickness are increasing. No immediate solution to the conflict is in prospect.

Other economic and social developments also give cause for concern. Gross domestic product has been stagnant since 1989. Dependence on foreign trade and external debts both grew markedly during the 1980s; and unemployment is relatively high and continues to rise. Rapidly rising criminal activities threatens internal security in parts of the country, and has led to a night-time curfew in several areas.

Even before gaining formal political independence, national political forces had proposed a programme of economic and social development based on self-reliance, social justice (a fair distribution of income, property and employment) together with development focused on regions which can be easily manageable, without resorting to large-scale projects. One year after independence, a government White Paper cited the following developmental objectives:

1. A rapid increase in the proportion of the economy under the control of Papua New Guinean individuals and groups and in the proportion of personnel and property income that goes to Papua New Guineans.
2. More equal distribution of economic benefits, including movement towards equalisation of incomes among people and towards equalisation of services among different areas of the country.

3. Decentralisation of economic activity, planning and government spending, with emphasis on agricultural development, village industry, better internal trade, and more spending channelled to local and area bodies.
4. An emphasis on small-scale artisan, service and business activity, relying where possible on typically Papua New Guinean forms of business activity.
5. A more self-reliant economy, less dependent for its needs on imported goods and services and better able to meet the needs of its people through local production.
6. An increasing capacity for meeting government spending needs from locally raised revenue.
7. A rapid increase in the equal and active participation of women in all forms of economic and social activity.
8. Government control and involvement in those sectors of the economy where control is necessary to achieve the desired kind of development.

In fact, as it is the case in many other developing countries, Papua New Guinea has been subject to a market-orientated model of development. This trend is characterised by production for the world-market and the use of imports to supply the home market. Whilst the world-market has generated a growing demand for Papua New Guinea's mineral and agricultural raw materials (gold, copper, oil, timber and cash-crops) high-income earners in Papua New Guinea in turn want products which are not produced domestically and which have to be imported (consumer durables, cars, electronic products, industrially-processed foods etc.).

However, this model of development did not come about, as it were, through the spontaneous operation of market forces. Rather, it was the outcome of deliberate policy. In the final years prior to political independence, the Australian administration systematically set about preparing the ground for the 'production of commodities for export'.² The World Bank also drew up a programme of world-market orientated development for Papua New Guinea in the 1960s centred on the exploitation of the

country's natural resources for export, and has continued to adhere to this approach.³

This strategy was adopted by the government of Papua New Guinea insofar as raw material production for export appeared to represent an appropriate vehicle for advancing a programme of development policies. Exploiting the country's natural resources was conceived as a means of obtaining investment capital, know-how and public revenues (including foreign exchange), which could then be used for national economic and social development. The government's approach was set out in the early-1980s in the following terms by former Minister for National Planning and Development, *Galeva Kwarara*, at a conference convened to draw up a preliminary balance of the first five years after independence held at the Institute for Applied Economic and Social Research, Port Moresby:

First, on the role of major mining projects and other natural resource-based ventures: we have said that we will welcome foreign investment in major mining ventures, because foreign investors bring capital and skills which we do not have. The resources themselves belong to all the people of Papua New Guinea. We have a well-established and widely accepted taxation regime, which ensures that the foreign investor will get a fair return on capital outlay, but which also ensures that the bulk of any windfall from the value of the resources will remain with our people. The reason we allow these resources to be exploited is to gain revenue. Often the resources are located in remote areas of less developed provinces (such as Ok Tedi and Porgera); but because the exploitation of these resources is by way of enclave projects, they produce little direct development of other activities in their immediate area. We cannot and do not plan these projects to bring development only to the local area. We plan for these projects to get revenue. What we then do with that revenue is a question of the utmost importance to developing this nation now, and for future generations.⁴

The World Bank's position, set out in its 1978 and 1982 recommendations, is similar:

The central development strategy for Papua New Guinea in the foreseeable future must be to use a very small number of enclave projects based

*on natural resources to generate the financial resources needed to carry out the Government's development objectives.*⁵

*Fully realising the contribution additional large enclave projects can make to Papua New Guinea's financial and external viability, the Government is actively pursuing four major possibilities - the Ok Tedi and Frieda River copper project, the Vanimo forestry pulp-mill complex, and oil and gas exploration.*⁶

PNG is rich in natural resources, and they play a large part in her developmental strategy. The development of large natural resource-based projects on an enclave basis is expected to provide the Government with the resources needed to carry out its developmental program. The Bougainville copper mine has fulfilled this role admirably, providing up to 27% of internal public revenue, and contributing to growth rates of GDP in real terms in the early 1970s Agreement has been reached for the construction of a new mine at Ok Tedi, beginning in 1981, which will have an impact similar to that of the Bougainville mine. Its initial impact on the economy will be through heavy expenditures on construction and a large demand for labour, but once production begins, of gold in 1984 and copper a few years later, the major impact will be through its contribution to self-reliance in Government revenue and the balance of payments

*A number of other major natural resource-based projects are expected in the future, as their initiation will be crucial to the Government's ability to carry out an expanding development program, particularly as Australian aid continues to fall.*⁷

The message is clear and the developmental logic expressed in it is very attractive at first glance. Papua New Guinea was to use its natural resources as means of obtaining necessary revenue for financing development. The exploitation of natural resources would be handed over to foreign companies, who would bring in capital and technology. All that the country had to do was give concessions, skim off a portion of the revenues from the production and export raw materials, and then employ the available resources for national development.

Above and beyond this, the exploitation of natural resources was also expected to yield a number of desirable spill-over effects, especially at local level. This includes the creation of employment, the extension of infrastructure which could also be used for other activities, and additionally promote opportunities in other economic spheres, such as creating a growing demand for locally produced goods and services.⁸

The possible negative effects of such enclave projects on their natural and social environment were either unmentioned or played down in the pronouncements of the government and the World Bank. For example, *Richard Jackson* (University of Papua New Guinea), who served as a government consultant on the Ok Tedi Project, commented - with evident reservations:

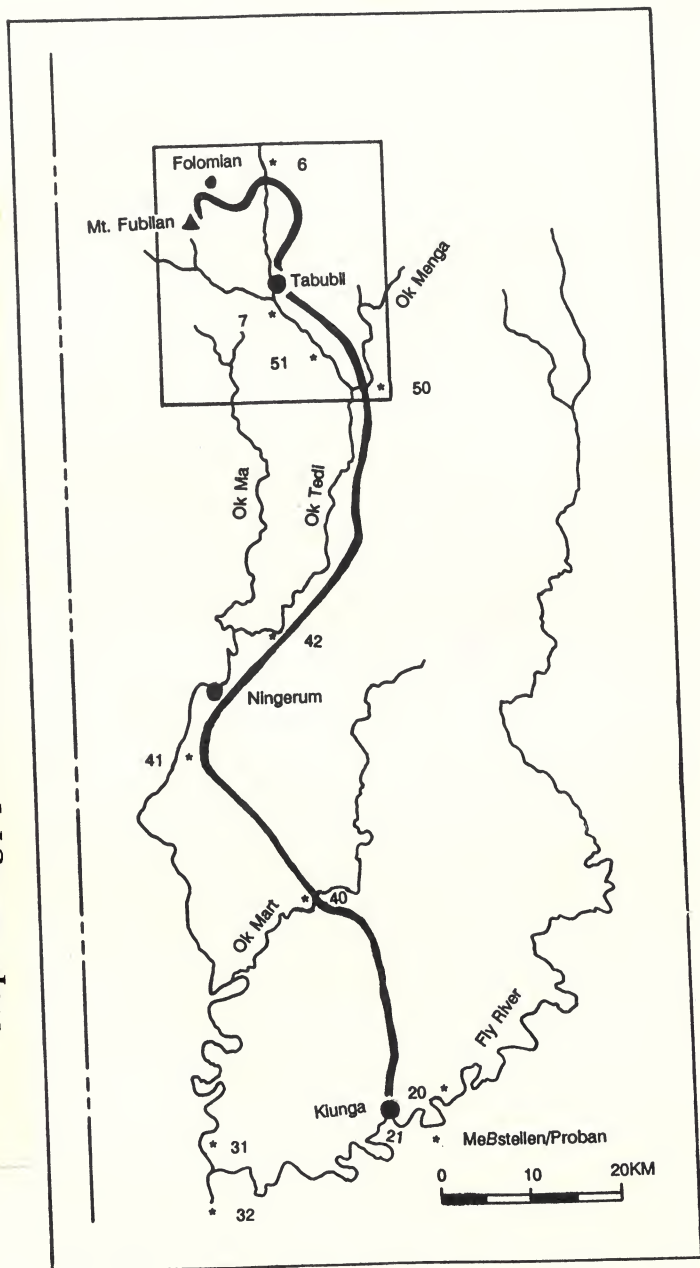
*The state's (PNG) policy on mining is, broadly speaking, that mining itself is not developmental necessarily, but is needed as the best way of raising large sums of money for 'real' development in as short a time as possible. Moreover, mining is most likely to occur in remote, mountainous, previously underdeveloped and thinly populated areas. Thus, the official argument goes, the benefits of mining are for the whole country, whilst the disbenefits caused by mining's negative impact upon the environment are suffered by a relatively few people.*⁹

Two large-scale projects in particular appeared to possess potential as vehicles for development by providing revenues derived from the exploitation of natural resources. They were the gold and copper mining operations of Bougainville Copper Ltd. (BCL) in Panguna (North Solomons Province) and of Ok Tedi Mining Ltd. (OTML) in the Ok Tedi Region (Western Province).

Based on a case-study of gold and copper mining in the Ok Tedi Region, and its associated impact on the natural and social environment of the region and the country as a whole, the present study examines whether these expectations have been fulfilled or appear likely to be fulfilled. Principally, the study is to find out whether these operations have

contributed to the economic and social development of both the region and the country in general, and whether it is in line with the proclaimed developmental objectives. Given the enormous scale of the Ok Tedi project and the fact that in many respects it is representative of other (large-scale) projects, our analysis of the Ok Tedi project is also intended to elucidate the overall developmental path adopted by Papua New Guinea.

Map showing pipeline transportation of concentrate



Chapter II

The Ok Tedi Project

Ok Tedi is a gold and copper mine in the Star Mountains of the Western Province, named after the Ok Tedi river (Ok = river). Initial explorations were carried out in the 1960s by the Kennecott Copper Corporation. Kennecott withdrew from the project in the mid-1970s. Ok Tedi Mining Limited (OTML) was established in 1981. The equity is held by Broken Hill Proprietary Co. Ltd. (BHPC) with 30%, the government of Papua New Guinea with 20%, Amoco Minerals Co. with 30%, and from Federal Germany, Metallgesellschaft and Degussa AG, each with 7.5%, and the Deutsche Investitions- und Entwicklungs - gesellschaft mbH (DEG) with 5%. Gold production began in 1984, and the extraction of copper ore in 1987. Copper concentrate is produced locally, primarily for delivery to copper refineries in Federal Germany, Japan and Korea. Metallgesellschaft has been responsible for marketing the concentrate since 1988. Gold

production ceased in 1989 with the levelling of the summit of Mount Fubilan and consequent exhaustion of the deposits. Gold is now only obtained as a by-product of copper smelting. Production in 1989 totalled 441 796 tonnes of copper concentrate with a copper content of 135 000 tonnes, a gold content of 15.8 tonnes, and a silver content of 30 tonnes.¹⁰ In the first six months of 1990, 246 064 tonnes of copper concentrate were produced.¹¹ Production is currently expected to continue for a further 15 years.

In addition to the immense technical difficulties and major planning errors, from its inception the Ok Tedi Project was beset by disagreements and conflicts between the foreign investors and the government of Papua New Guinea. Further, still, there were subsequent conflicts between the mining company and local landowners, who initially were hardly able to gauge what mining operations would mean for their region, as well as between the company and its employees.

Kennecott lost interest in the project once it found that it was unable to get total exemption from taxes and royalties from Papua New Guinea's first independent government.

The later disagreements between the foreign shareholders in Ok Tedi Mining Ltd. and the government were also basically for financial reasons, ranging from the raising of capital and loans to the opening of the mine and the distribution of earnings. In addition, there were - and still are - conflicts about the financing of necessary infrastructural investments and the costs of maintaining this infrastructure. The beginning of mining operations also triggered an increasing number of disputes over compensation for environmental damage.

Following the start of gold production in 1984, the company announced that it would not continue with copper production once gold deposits were exhausted in 1989, as originally planned, but rather intended to close the mine down. The government reacted with an

ultimatum which threatened to stop operations immediately. In return for an agreement from the company to continue with the project, including the production of copper concentrate, the government withdrew its initial insistence on the construction of a dam and a retention basin for receiving tailings, originally planned on environmental grounds. This was one of the reasons why the company wanted to abandon the scheme to continue to extract copper ore and produce copper concentrate.

In a whole-page press announcement in November 1990, Ok Tedi Mining Ltd. stated:

Day by day, the Ok Tedi mining operation is bringing investment and benefits that will enrich the lives of Papua New Guineans through many more Independence Days to come.

A mining operation the size of Ok Tedi represents a 'life chance' for the people of PNG's remote Western Province. Communities are richer now, in terms of more roads and schools, better health facilities, growing opportunities for spin-off businesses.

The national economy is also richer, thanks to increased export earnings and revenue from royalties, taxes and other levies.

Ok Tedi has only been in PNG for eight years. In that time Ok Tedi has accounted for 70% of all capital expenditure in the country. Our output last year made up 30% of PNG's export earnings.¹²

The government also expected the project to yield 'jobs, roads, a new town and a new port' for the people of the Western Province, and also bring in a substantial increase in tax revenues for the state.

Have these expectations been fulfilled, and are the claims made by the Ok Tedi mining company that it would contribute to national development warranted? Have the people of the Western Province been given jobs, roads, a new town and a port? Is the country richer? What effects does this large-scale project have on the natural and social environment? The following sections address each of these issues individually.

Capital expenditure, budgetary and foreign currency revenues

According to the Ok Tedi mining company, US\$ 1.4 million were invested in the mining project in the years to 1989. Of this, about 20% was raised in the form of equity capital (Kina 300 million), 54% of investment costs were financed through loans (of which one third, US\$ 270 million, were converted into preference shares in 1986), with the remaining 26% financed through earnings from the mine's gold production between 1984 and 1989.

Foreign shareholders equity thus contributed only about 16% of total investment outlays, or Kina 240 million. However, even those funds described in the balance of payments statistics as capital inflows do not accrue to the country as a whole. The fact that they are earmarked for the mine means that they are not available for development tasks or projects. Instead, the government of Papua New Guinea had to inject substantial capital sums into the mining project. Acquiring the state's share in the company entailed raising Kina 60 million, which was, as a consequence, denied to other projects necessary for national development.

The high share of borrowed capital in the project means that over the long term, net capital outflows will be recorded. Debt service for foreign loans claims a substantial proportion of foreign exchange receipts from copper exports. According to World Bank estimates, servicing the long-run liabilities of the mining company, which were put at US\$ 486 million in 1986, will account for over 40% of 'annual cash operating costs' from 1990 onwards.¹³ And inasmuch as these loans are guaranteed by the government, the state must step in to maintain debt-service payments should earnings from the mine prove insufficient.

And although the company's contention that 70% of all capital expenditure in the country was accounted for by the mine between 1982

and 1989, as claimed in its newspaper announcements of 22nd November 1990, this may not be wholly correct (the figure probably relates to the total of private investment). Such an observation nevertheless suggests a highly imbalanced pattern of investment in the country, and also reveals that the mine itself has triggered barely any investments in other regions or sectors, or contributed to such investments. Rather, the immense capital needs of the mine have sucked in capital from other regions and sectors, at the expense of alternative investments and economic activities.

What is the situation as regards revenues from current production, and profit and tax transfers to the state?

Although the mine is currently producing at maximum output and costs and revenues appear to be developing very favourably ('the present state of mining at Ok Tedi is a most successful operation', according to a Vice President of the shareholder Broken Hill Proprietary Co.), no distribution of profits has been promised to the shareholders, and also to the government, before 1992. Declared profits for 1988 of Kina 20.7 million and for 1989 of Kina 24.2 million have both been on the low side.¹⁴ Since production began in 1984, the state has received no income from its shares in the mine. Any declared profits in individual years since 1984 have been used for investment or debt-service.

According to Jackson, total dividend payments to the state over the anticipated life of the mine of around 25 years were originally expected to be Kina 470 million, with Kina 1.89 million going to the foreign shareholders.¹⁵ Even if payments of these amounts to the state were given, (which is highly unlikely given the number of years in which no profits were recorded) the argument that exploitation of the country's natural resources, in this case gold and copper, would yield sufficient profits to finance national development remains unsustainable. Only a very small fraction of declared profits remains in the country, the bulk flows

abroad. And this excludes any export of non-declared profits or profits transfer via intra-company transactions (transfer pricing).

In 1989, the company paid the state the meagre total of Kina 19 million in taxes, royalties, import duties and rent on a total turnover of Kina 460.4 million.¹⁶ In 1990, according to the company, these payments will rise to Kina 30 million. The company expects to pay a further total of Kina 750 million during the remaining life of the mine.¹⁷ However, the fact that no such payments were made between 1981 and 1986, with only small payments made in 1987 (Kina 7.8 million) and 1988 (no precise figures),¹⁸ means that over the operational life of the mine a total of about Kina 820 million will accrue to the state in the form of taxes and royalties.

The original plans envisaged much higher payments. However now this cannot be expected. In 1982, for example, Jackson cited a maximum possible tax take from the Ok Tedi project of US\$ 2,900 million.¹⁹ It now appears that the state might not even receive one third of the originally expected payment from taxes and royalties.

Financial returns to the region - the Western Province - from gold and copper mining are meagre. The only direct payments to the government of the Western Province are 'mining royalties', estimated at Kina 2 million for 1990.²⁰ Landowners receive agreed compensation payments as stated in the contract for the use and exploitation of their land, which can also only be termed minimal when compared with the enormous amount of land taken up by the project. Besides, the project presents irreversible destruction even if some landowners may receive a relatively high income for a while. Agreed compensation varies according to land-use (mining, residential, road building); according to the company, Kina 1.7 million was due in 1990.²¹ Jackson put the total amount of compensation to be paid, assuming an overall mining turnover of US\$ 10,000 million, to US\$ 25 million.²²

Those revenues which accrue to the province and the country from the mine have to be set against the substantial amounts of public expenditure undertaken on behalf of the mine. These include the costs of financing all those activities and services which are normally borne by governments in connection with such large-scale projects, such as acquiring foreign expertise. Finally, the state - including both provincial and national government - may also have to bear the high costs of countering the increasingly evident negative effects of mining operations. As the composition of public expenditure in the 1990 budget reveals, the amount left to the state from mining revenues, and actually available and employed for national development projects, are currently insignificant. And there are also grounds for concern that the additional tasks which the state might well be called on to perform could still further reduce these net gains in the future.

Foreign currency receipts from the export of copper are a major item in the balance of payments. In 1989, the company declared export receipts of Kina 460 million, around 40% of Papua New Guinea's total export earnings in that year. However, mining operations are highly import-dependent and a substantial slice of foreign currency receipts from the export of copper, in addition to that devoted to debt-service, goes to imports of equipment, supplies, fuel, and spares for the mine and for payments to the mine's foreign employees. On balance, the state probably receives in foreign currency earnings from copper exports roughly the same amount as it receives in tax and profit income from mining activities, equal to less than one-fifth of total foreign currency earnings.²³

Infrastructure

In order to supply the mine and transport copper concentrate, the Ok Tedi Region - previously a highly inaccessible area - was endowed with an infrastructure during the course of the 1980s which appears to be

a very impressive site. A town for the mine's employees (Tabubil), a 137 km road to supply the mine (Kiunga - Tabubil), with a further 60 km of roads around the mine's periphery and in the towns (Folomian, Tabubil), a 150 km pipeline for transporting the concentrate (Folomian - Kiunga), an airport, a riverport (Kiunga/Fly River) and a power station (Ok Menga) were all newly constructed, together with other facilities such as a school, a hospital, repair shops, and a hotel.

Almost all of these facilities have been built, exclusively to meet the needs of the mine and its employees. Only very limited use is granted to local residents, to the provincial government and to other groups.

The transport facilities reveal that typical vertical structure characteristic of the transport systems of raw-material exporting countries: transportation of raw material from deposit sites to the export terminal and in the reverse direction transporting of supplies from import depot to the mining site. No initiatives towards extending the road network into the Ok Tedi Region or elsewhere in the province have been undertaken in the wake of mining operations. Not even to meet the secondary needs of the mine, such as provision for transporting fresh food from the surrounding area.

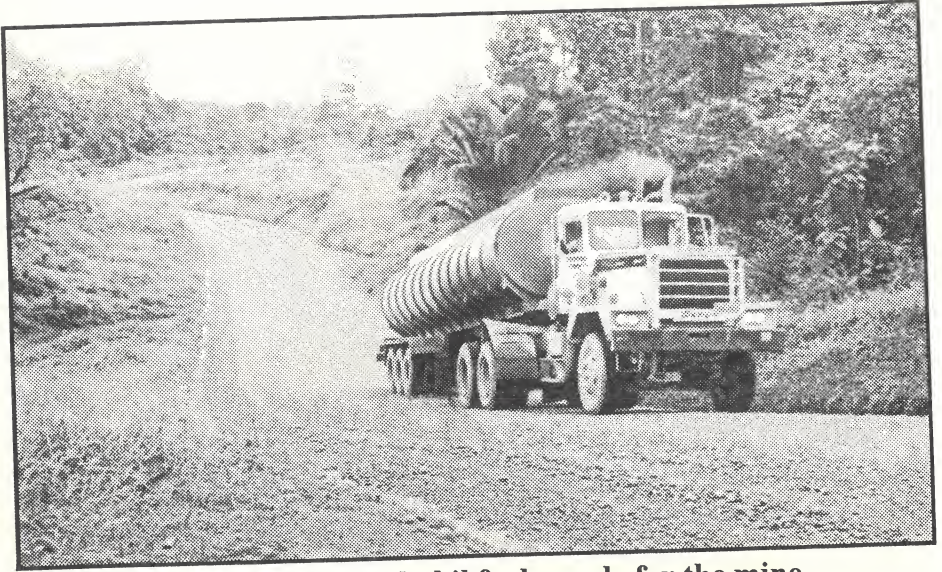
Most of the equipment, fuels and other cargo for the mine, including supplies for the local and expatriate employees, are transported by ships (Port Moresby - Kiunga) and then by trucks from Kiunga on the new road. The copper concentrate is initially carried by pipeline from the mine to Kiunga where it is filtered, dried and loaded onto ships with a capacity of 2.5 tonnes for transport to the Gulf of Papua. Here another vessel serves as a terminal from which the concentrate can be loaded onto ships which carry it overseas.



Fly River, transportation of copper concentrate

The government of Papua New Guinea advanced about US\$ 50 million for the construction of the road from Kiunga to Tabubil. This money is supposed to be paid back to the government within 15 years via user charges for the road payable by the mine. Since the road was designed to meet the stress imposed by heavy vehicles, its construction would certainly have entailed substantial, though not fully published, costs. The same amount of money invested in meeting the less demanding needs of the people of the region would not only have been sufficient to build a link road but also create an entire network of lower grade roads better suited to local transport requirements.

The use of the road itself is also subject to a number of limitations. When convoys of mine trucks are approaching, headed by a pilot vehicle, followed by a varying number of tankers, articulated container lorries and heavy trucks, and with the tail-end brought up by a tyre truck, other road users have to either leave the road immediately or park at the roadside and wait until the convoy has passed by.



Road Kiunga - Tabubil fuel supply for the mine



Road Kiunga - Tabubil, transportation of quicklime

Other infrastructural facilities for the mine are also financed or co-financed by the government, or their running costs met by the state. This applies, for example, in the case of educational and health facilities. In order to install a telecommunications system, the government borrowed money from the company, to be paid off from the revenues payable to the state from the mine's operations.

As already stated, much of the infrastructure built for the mine is either inappropriate to local needs or unavailable to the local, largely rural, population. Once the mine finally closes down when mineral deposits are exhausted, it will either no longer be needed or will no longer be maintained.

A comparable financial input by the state, but tailored to local needs, could have yielded a much more appropriate infrastructure. Those facilities and services established by the Montfort Catholic Mission in the Western Province in transport, education, health and even in commerce would appear to be both better suited to local needs and more geographically encompassing than the facilities and services available, and then only to a restricted extent, to the population in the vicinity of the mine.

Tabubil is a wholly artificial town, which has not grown naturally nor been designed or built for a long life. Its main function is to house the expatriate specialists, and their families, employed by the mine, with some provisions for local employees from the Western and other provinces, and to a limited extent their families. Last of all, it does not cater for the majority of the population of the region not employed by the mine or in the town.

Only limited facilities for environment protection have been provided, such as a sewage treatment plant in Tabubil, and research and laboratory facilities for the mine, including a research and laboratory ship primarily for monitoring environmental change and damage. A number of vitally important facilities for protecting the environment and conserving the

natural foundations of life envisaged in the planning stage and prescribed in the mine's operating licences have not, as yet, been constructed. These include the dam and a retention basin for tailings, which have so far been discharged into the drainage systems of the Ok Tedi and Fly rivers.

Employment

The mine currently provides employment for 3 200 workers. 1 700 are directly employed by Ok Tedi Mining Ltd., with a further 1,500 employed in ancillary and supply firms. About 85% of the workforce are nationals, with 15%, around 460 predominantly managerial employees, from abroad.²⁴

At first glance, and measured against the Western Province's total population of 78 000, of which approximately half are of economically active age, the mine would appear to offer an opportune employment potential. However, the number of jobs available for work-seekers from the Western Province is in reality very modest. Only about 30% of nationals employed by the mine are from the Western Province.²⁵ Most come from other parts of the country, and especially more recently from Bougainville. In view of the claim that 70% of the total national capital investment over a period of eight years was accounted for by Ok Tedi, the employment generating effect of the mine, not very significant for the region, is extremely low for the country as a whole. The mining sector in Papua New Guinea employs only 1% of the labour force.

Besides this, the variety of employment offered by Ok Tedi is extremely imbalanced. Most employment is taken up by male semi-skilled or highly qualified employees. And given the prospect of only a few decades of operational life, that employment which is available to local work-seekers is only for a short period.

Impact on the natural and social environment

It is a well-known fact that mining operations at Ok Tedi have imposed massive burdens on the environment. What is controversial is whether these burdens will lead to permanent environmental damage and whether they represent an enduring threat to the natural foundations of human life in the region.

Currently some 70,000 tonnes of ore are mined daily and processed into copper concentrate. The waste rock and tailings from the production of the concentrate (c. 98% of the ore), totalling 150,000 tonnes a day, are either discharged directly into the Ok Tedi (tailings) or dumped and washed into the river by the rain (waste rock). A large proportion of this sedimentary load is carried via the Ok Tedi into the Fly River. According to the company, the Ok Tedi and Fly River systems have to carry an additional load of 70 million tonnes a year at full production, more than 1,000 million tonnes over the life of the mine.²⁶

The known effects on the environment so far have been very profound. Not only is the water in the two rivers, the lagoons and the Fly River delta under strain, but the sedimentary deposits also impose a burden on the land in the river regions. Copper in solution and other heavy metals can make the water in both rivers toxic to fish and undrinkable for humans. The sedimentary load which reaches the Gulf of Papua threatens to destroy the spawning grounds of the barramundi, an edible fish of both nutritional and commercial importance. According to the mine administration, fish stocks in the upper reaches of the Ok Tedi have already fallen by 50-80% after only a few years of operation.

The beds of both the Ok Tedi and Fly River will be raised quite substantially by these sedimentary deposits. Floods and deposition of mining sediment could make agricultural areas (gardens) in the river regions infertile and damage the forest. The lagoons of the Fly River have

also been affected by floods, damming up, and sedimentary deposits with all their associated problems. Changes in the river bed also impair navigation on the Fly River.

The environmental burdens and damage caused by mining operations, primarily through the discharge of tailings and the dumping of waste rock and its washing down into the drainage systems of the Ok Tedi and Fly River, were predictable. Therefore, the operating licences for the mine stipulated the construction of a dam and a retention basin to trap the sediment, as recommended in the relevant technical literature.

Shortly after work had begun on the dam in February 1984, a landslide evidently made it impossible to build the dam on the originally envisaged site. In 1986 the government agreed to a compromise which permitted the unlimited direct discharge of mine waste into the Ok Tedi until 1990, and also conceded a grace period before construction of the dam and basin had to begin. In view of this agreement, it is not unreasonable to suppose that at that time neither the government nor the company regarded the building of the dam as a serious prospect. Maintaining production and securing monetary earnings and receipts took precedence over measures indispensable for the protection of the environment. The shutting down of Bougainville Copper Mine and the consequent shortfall in public and foreign currency receipts also led the government in 1989 to suspend the agreement which provided for the construction of the dam in 1990. The discharges, currently at a volume produced by full production at the mine, can now continue indefinitely and on an unlimited basis.

The current and enduring damages to the natural environment, caused by the mine's operation, are not without social effects. The damage to water, the reduction in fish stocks, the deposition of mining sediment, including on agricultural land, all threaten either to impair or destroy the natural foundations of life for those people living on

subsistence economy in the river regions. More people will be compelled to migrate to urban areas to swell the number of those lacking employment or an income. Others will be forced into what, in the long term, is a financially insecure state of dependence on the compensation payments made by the mine.

The company itself appears to either ignore or minimise these highly problematic ecological and social developments. Insofar as environmental damage is acknowledged, the company would seem to regard it merely as a temporary and unavoidable accompaniment to the operation of the mine which will vanish once the deposits are exhausted. The monitoring of the environment, carried out at some expense, by the company, is evidently only undertaken to confirm the innocuousness of the mine to the environment, as they see it, a fact of which the company already appears convinced:

Ok Tedi Mining Limited has announced a K2 million research program to confirm (sic) that its mining operations are not adversely affecting the Fly River estuary, Gulf of Papua or Torres Strait

'We are expecting the program to confirm predictions resulting from our initial studies that Ok Tedi's operations are not adversely affecting these areas'.²⁷



Northern discharge of tailings



The Ok Tedi River south of Ningerum, sedimentary deposits

Chapter III

Environmental Damage in the Western Province of Papua New Guinea by the Ok Tedi mine

Prepared by Lutz Castell, Institute for Environmental Damage and Research

Knowledge and understanding of the tropical rain-forests is still very limited. The multiplicity of species, for example, was underestimated by a factor of ten as recently as a decade ago. This diversity is one response by evolution to the shortage of plant nutrients in the soil. The unavoidable washout of vital minerals, which are then transported to the sea, is primarily compensated for in nutrient-poor soils and rivers by rain-borne aerosols and nitrogen compounds. As a consequence, the 'natural' density of population for both humans and other large mammals on the poor soils of the tropical rain-forest is very low. Before the arrival of Europeans, a

higher density was only possible in the fertile regularly flooded-areas along white-water rivers, in hill-forests, in upland areas or on volcanic soils. Conversely, even where rain-forests have been left untouched for centuries, there is no prospect of high fertility. There are no untapped reserves of land. Only where the soil contains three-layer (2:1) clay minerals, and enough humus is available, can the soil retain sufficient plant nutrients. Nutrients are washed out of sand and kaolitic soils too quickly. The only form of enduring limited agricultural land-use in areas with somewhat richer soils is migratory farming using 'gardens', which are less than a hectare in size (often only 0.1 -0.03 ha), and gathering. The view still taken by the FAO in 1980 that potential yields in rain-forest areas could exceed those of temperate latitudes by three or four times utterly ignores the soil-structure of the tropics. One fact has become increasingly clear over the last two decades is that no eco-system in the world is as sensitive to human intervention as the tropical rain-forest.²⁸

The purpose of the ecological tests carried out in the present study, is to contribute to an assessment of the differing opinions and disputes which have arisen between the mining company, the government and the local population with regard to the impact of mining. This study has been carried out through **direct** observation, using **new** measurements and **independent** evaluation of the results. (See appendix 6) In one month in mid-1990, samples were taken at 14 locations on the Ok Tedi-Fly River system in the Western Province of Papua New Guinea. Up to 50 physical-chemical tests were made on each sample, partly on the spot and partly by scientific laboratories in Germany. While the number of samples is not sufficient to provide the empirical basis for a comprehensive analysis of the relevant ecological issues across the whole territory, the samples taken at these carefully selected locations do yield very important results, which put together with the various Ok Tedi Environmental Studies allow an evaluation of the ecological situation and future damage. In order to better follow the analysis, evaluations and issues raised by the individual

measurements referred to below, readers are recommended to consult the appended map for an overview of where individual measurements were taken within the drainage systems of the Fly River, the Ok Tedi, its tributaries (Ok Menga, Ok Mart) and in the Gulf of Papua relative to the mine.

The first measurements taken were from a sample of rain-water at Kiunga/Fly River. The result, 0.01 mg of dissolved copper per litre, raised a number of issues. It is unlikely that the measurement was the result of contaminated sampling equipment. Nevertheless, it posed the question of how this copper could have got into the rain-water. For example, could it have originated in the steam from the copper concentrate conditioning plant in the port, some five hundred metres distant, where the pipeline from the Ok Tedi mine at Mount Fubilan ended? Or could it have come directly as an aerosol from the tailing dumps of the Ok Tedi mine, 105 km north in the Star Mountains, or from the contaminated river sediments of the Ok Tedi? Moreover, we do not know what pollutants are contained in the local drinking water supply which runs off the corrugated zinc roofs into blue plastic drums, made in Germany, previously containing hydrogen-peroxide. Industrially used zinc also usually contains, in addition, the heavy metals lead and cadmium which the warm and very soft rain-water, with a pH-value of c. 5.6, is able to dissolve over time. (On the other hand, the low level of minerals such as calcium and magnesium in the rain-water places a question mark over its long term use as drinking water in the Western Province). This in turn raises the question of whether the river water is drinkable. The use of plastic drums to collect rain-water suggests not. Moreover, are fish able to survive in the Fly River and Ok Tedi, given the stress imposed by the annual load of 60-70 million tonnes of waste rock and tailings originating from the mine, and are there sufficient plant nutrients for the river's fauna, beginning with algae? The population is also worried about being poisoned by cyanide and heavy metals.

At the port in Kiunga a new sewage pipe, through which effluent (sample 2) from the municipal treatment plant is discharged directly into the river, yields a copper content measurement of 5.5 mg/l. However, because the level of concentration of toxic substances harmful to biological processes in sewage treatment plants is in the range of 1-3 mg/l Cu, the waste water from the conditioning plant cannot have been indirectly discharged (prescribed limit 2 mg/l) and have first passed through the treatment plant. In all probability, the industrial effluents are directly discharged into the sewage pipe below the treatment plant. That is, the industrial effluents are merely diluted by the municipal sewage effluents and leave the plant in even higher concentrations. Why then, does the Ok Tedi Mining Company not install a detoxification plant which could precipitate the copper compounds in an alcoholic medium? Copper in solution is strongly toxic to fish, and its effect is magnified by the simultaneous presence of zinc and lead (synergy). The prescribed limits for copper in Federal Germany are as follows:

	Copper (mg/l)
Requirements for minimum quality for running water (water quality category II/III)	0.05
First action threshold	0.06
Requirements for fishing waters	Dissolved copper (mg/l)
(Water quality class II)	
Cyprinidae waters (e.g. for carp, which are rated as medium-sensitive)	
	hardness CaCO ₃ 10 mg/l 0.005
	hardness CaCO ₃ 50 0.022
	hardness CaCO ₃ 100 0.04
	hardness CaCO ₃ 300 0.112
EC Directive on Quality Requirements	Copper (mg/l)
for Surface Waters for Obtaining Drinking Water	
(Treatment Category A1)	0.05

Why are prescribed limits for copper in those rivers in the Western Province of Papua New Guinea affected by the Ok Tedi mine so much higher than the German or European limits?

Copper in solution (mg/l)	0.05
PNG copper standard (for filtered water, 450 nm membrane)	0.115
Adjusted PNG copper standard (total particulate)	0.230

What factors prompted the setting of such high limits, which still cannot be complied with in the Middle Fly during mining operations? Even the last of these listed limits was substantially exceeded in the Fly River 5 km south of D'Albertis Junction (sample 32 - see map), where a measurement of Cu (mg/l) 0.328 was obtained. What conditions were these limits adjusted to? And why are they **four times** the limit prescribed in the **European Community Directive**? The most important physical-chemical parameters were measured in the entire drainage system before mining activities began in 1984.²⁹ Measurements taken in rivers in the Star Mountains, as yet unaffected by mining, were also taken as part of the present study to obtain a second independent standard.

The Ok Mart, a tributary of the Ok Tedi, and unaffected by waste rock and tailings, is crossed some 36 km north of Kiunga on the road which leads to Tabubil (135 km) and thence a further 35 km to the Ok Tedi mine. The following measurements were taken from water in mid-stream:

- Temperature (t, degrees Celsius)
- Specific conductivity (S/cm, microsiemens per cm, at a reference temperature of 25 C)
- pH-value
- Turbidity (in 1/m, or in formazin turbidity units FTU)
- Total hardness (as CaCO₃ mg/l)

Specific conductivity is a measure of disassociated inorganic ions (salts). The 'electrolyte-rich' waters of the western Amazonian periphery near Manaus have values in the range of 38-60 S/cm and a pH-value of 6.5-6.9. (pH-value is a qualitative measure for acidity, pH, or alkalinity, pH7.) The total hardness of these Amazon waters corresponds to 14-24 mg/l CaCO₃. (1 dH German degree of hardness corresponds to CaCO₃ 17.8 mg/l, or Ca 7.14 mg/l). Turbidity in similar waters is an indicator of the undissolved material in the water. (1 1/m = 6.2 FTU reduces the intensity of a beam of light passing through it at a depth of 1 metre by 10%, at a wave-length of 620 nm).

The results obtained at the Ok Mart (sample 40) fit closely to the corresponding values from the western Amazonian periphery near Manaus:³⁰

t = 24.5 C

Cond. = 28.3 S/cm

pH = 6.98

Turbidity = 3.9 1/m = 24 FTU

Total hardness = 18 mg/l CaCO₃

If one compares the heavy metal content (see Appendix 2) of the sample from the unaffected Ok Mart against the water quality criteria for carp, it is noticeable that the values for Hg, Cu, Pb, Zn, Cd are well below the recommended levels (cf. Bohl 1982, Appendix 1). Only the iron content approaches the action threshold of 0.9 mg/l. The arsenic content of 0.002 mg/l is also lower than the action threshold of 0.01 mg/l, and does not reach the limits prescribed in Federal German drinking water regulations of 0.01 mg/l As. Turbidity comes close to the recommended limit of 25 FTU for cyprinidae which is to be expected in tropical rivers.

The situation on the Fly River above Kiunga (sample 20) is similar. Its higher copper and iron content can still be viewed as 'natural'. The measurements for the other parameters were as follows (with the average

values from the Ok Tedi Environmental Study, 1 Main Report, pp. 37 and Vol. 2, p. 108) given in brackets):

t = 24.1 C (25)

Cond. = 112.8 S/cm (115)

pH = 7.54 (7.0)

Turbidity = 5.3 1/m = 33 FTU (34)

Total hardness = 58 mg/l CaCO₃ (64).

The fact that the pH-value was half a unit higher may be related to the time of day at which our measurement was taken (16.20), compared with the average value of the Ok Tedi measurement in 1982. Assimilation by water plants (removal of CO₂) increases the pH-value by several decimal places in the afternoon.

Up to its confluence with the Strickland River, the Fly River has a fairly low **natural** sedimentary load.³¹ The very different sedimentary loads of the two rivers is the reason for the differing alluvial landforms and patterns of vegetation along the Middle Fly and Strickland.

A comparison can now be made between the values obtained in the rivers before mining operations began and at those locations now subject to pollution, beginning with the sample (7) from the bridge south of Tabubil. The **copper** content here is c. **1000 times** higher than before mining began; the **iron, manganese, zinc** and **lead** content is c. **200 times** greater; the **arsenic** content and the **turbidity** c. **100 times** greater.³² These are shocking figures and represent industrial effluents on a scale not permitted in any river in the western world. If they are compared in terms of broad orders of magnitude with the values for the Rhine at Koblenz, at the height of its pollution in the 1970s (the precise figures are subject to considerable fluctuation) then the level of **zinc pollution** of the Ok Tedi is c. **20 times** higher, of **cadmium 10 times** higher, of **copper 170 times** higher, and of **lead 50 times** higher.

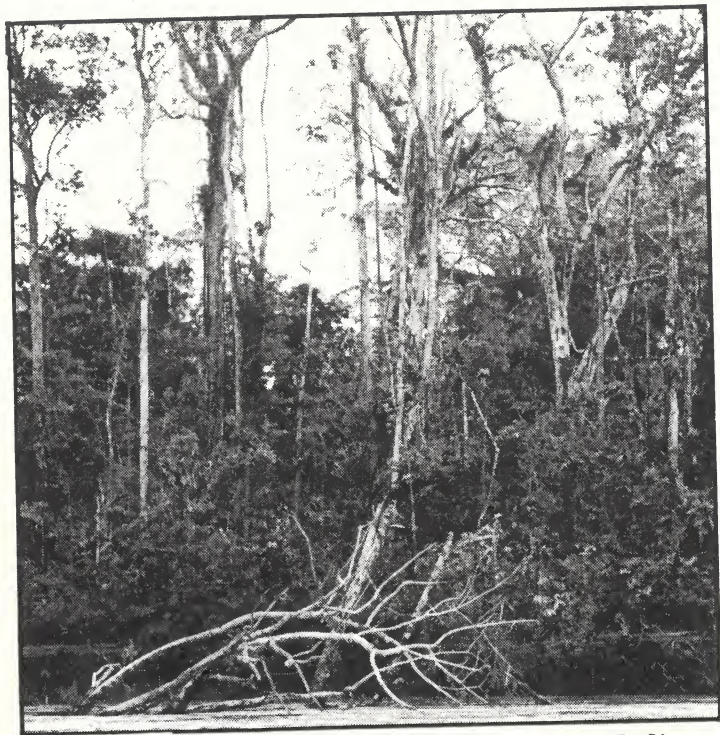


Healthy rainforest at the Fly river, before the junction with the polluted Ok Tedi river

The low-lying rain-forest is subject to considerable flooding, with the level of the Fly River fluctuating by up to 8 metres.³³ The swamps bordering the Middle Fly were typically 16 km across before mining operations began.³⁴ According to the company, over time the river bed will rise by 2-3 metres as a result of sediments originating in the open-cast operations on Mount Fubilan. This will considerably enlarge the regularly-flooded area adjacent to the river as the drop of the Fly River between Kiunga and the sea is less than 20 metres. Because deposition of sediment, which contains between **1g** and **5g** particulate **copper**³⁵ per kg sediment, will increase in this flooded area, the barely one centimetre deep humus layer in the rain-forest in this area will soon exhibit a similarly high copper concentration. (Up until 1982, the copper content of the sediment used to be 0.03-0.05 g/kg, lower by a factor 100). This is easily demonstrable, as the total annual sedimentary load of the Ok Tedi and Fly River from mining operations distributed evenly across the flood plain would produce an

annual deposit on average some 0.5 cm in depth! The prescribed heavy metal limit for sewage sludge on agricultural land in Federal Germany is 1.2 g/kg copper per dry weight of sludge. Putting sewage sludge on agricultural land is **prohibited**, if the soil already contains more than **0.1g copper per kg earth**. We do not know where this limit is exceeded, and what levels of copper concentration (toxic limit 0.2-0.4 g/kg Cu) in the sensitive eco-system of rain-forest are correlated with the observable dying off of trees on the lower reaches of the Ok Tedi (see photographs). However, it is more than probable that a close connection exists between the increasing infertility of these regularly flooded areas and the copper content of the sediment. (Colour infra-red aerial photographs could give an initial overview of the position).

Dying forests are not the only consequence of the intense stress on the river caused by sediment. These sediments do not originate in normal, gradually occurring processes of erosion but from the freshly ground sand, with a particle size of 0.2-0.05 mm, produced by the mine's stone-crushing plant. Normal rounded particles, which are pushed through fishes' gills with water in the act of respiration, are less problematic, even in high volumes, than the sharply-edged, irregularly-shaped particulates which can injure gills, and render fish susceptible to fungi and other infectious agents. And because the bed of the Fly River is constantly being covered with new sediments, many organisms are fatally affected. The development of algae, which lie at the beginning of the food-chain, is no longer possible in these rivers as the increased turbidity, some 100 times higher than before mining, does not allow sufficient light to pass into the water to permit plant-growth. Biomass production falls to zero.



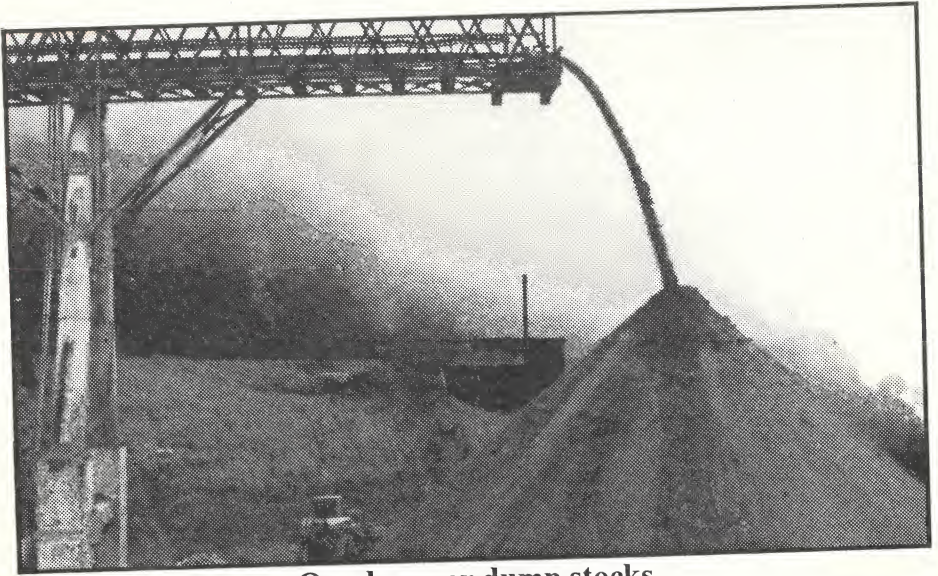
Dying forest at the lower course of Ok Tedi

Michael Goulding has observed for the Amazon Basin that many species of fish feed on the fruits of the rain forest. During high-water, the fish (for example, the Northern spotted barramundi, *scleropages jardini*) swim far into the flooded rain-forest and consume material floating on the surface. The small shallow lagoons also serve as fish hatcheries. Many species spawn there and grow into fry. Caymans (South American alligators) also play a critical role in the nutrition of the fry because their excrement contains the necessary nutrients. As long as there were enough caymans, fry stocks were high.³⁶ Similarly, fish stocks in the Fly River are not only being directly reduced by the extremely concentrated sharp-edged sediment, or the high pH-value of the river-water (alkalosis begins

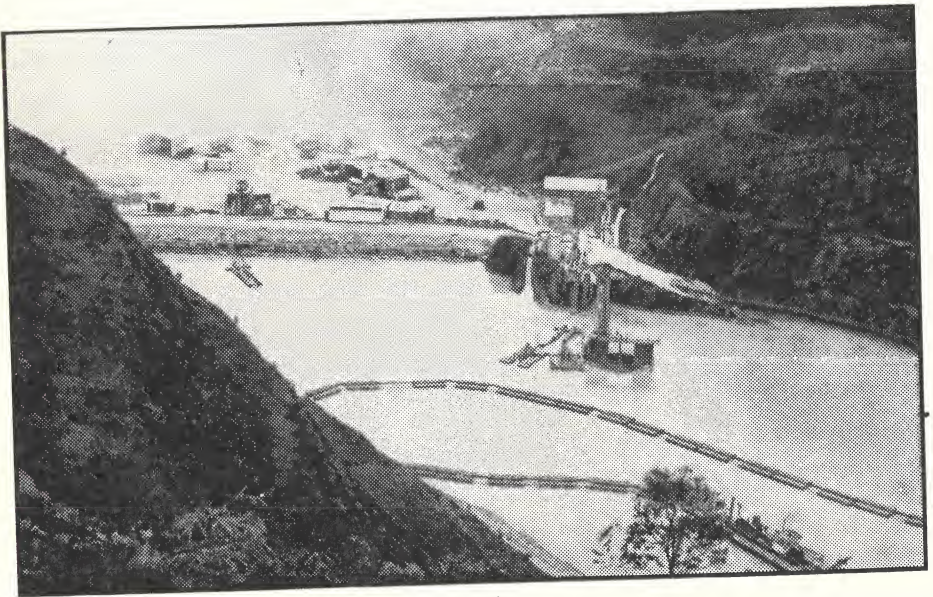
at a pH-value of 8.5), or the high copper content, which can induce vibriosis³⁷ and its reinforced effect via zinc and lead, but also indirectly through the onset of forest-death, with corresponding loss of food. It is naive to believe that the fish population will fall to 30-50% of its pre-mining level, as claimed by the company. Given such massive interference with an extremely fragile eco-system, it is highly likely that the entire system will break down rather than settle at the low level which, according to the company, is more than enough to feed the local population as only 10% of the fish are needed.

These facts put the comment made by the naturalist *D'Albertis* over a century ago about the sand and mud of the Alice River (Ok Tedi) into a new and grim light. 'This mud perhaps hides the metal which may one day change New Guinea into a civilised country'.³⁸ Certainly, *D'Albertis* could not have imagined the scale of environmental destruction which this 'civilisation' is capable of wreaking.

What will be the further effects of these depositions of the river's sedimentary load? The pH-value of the Ok Tedi at Ningerum and of the Middle Fly at Kuambit has been increased by one unit through mining. The causes are the large quantities of quicklime CaO which are used in the flotation of the copper ores and which end up in the river-system, and the undissolved limestone (CaCO_3 , $\text{CaMg}(\text{CO}_3)_2$), contained in the waste rock. In addition, Xanthate and dithiophosphate esters, which are potential carcinogens when used as insecticides, are also used in flotation. Thus, the Ok Tedi at Tabubil has a calcium and magnesium content of 870 mg/l and 46 mg/l respectively. However, only c. 1/20 is dissolved as hydrogen-carbonate $\text{Ca}(\text{HCO}_3)_2$. The undissolved calcium carbonate CaCO_3 buffers the pH-value at 8.5, as any additional free carbon dioxide CO_2 is immediately bound as hydrogen-carbonate.



Ore dump or dump stocks



Flotation

The heavy metals in the sediment are mostly in the form of sulphides and are only soluble to a limited degree at a pH-value of 8.5. Only c. 1/100 of the copper is present in dissolved form. The concentration at Ningerum at the beginning of 1989 lay between 0.01 and 0.08 mg/l for copper in solution.³⁹ This exceeds the action threshold for fishing waters of 0.025 mg/l for copper in solution and reaches the toxic threshold for fish of copper in solution of 0.08-0.8 mg/l. However, the sediments deposited in the flood plain are subject to rainfall with a pH-value of c. 5.6. This rain gradually dissolves metal ions and renders them available for absorption by plants. Moreover, this region has one of the highest rainfalls in the world with 2,400-9,000 mm per year. At the same time, toxic hydrogen sulphide H_2S is also formed. A similar process will take place with the river sediment once the pH-value falls back when mining operations end and there is additional bacterial activity. The chalk, which currently ends up in the tailings because of the company's operations, controls the acid mine drainage.⁴⁰ However, this will be swiftly washed out once mining ceases, leaving no further obstacle to the increased mobilisation of the metal ions.

Arsenic, which can induce cancer in humans, is much more difficult to demobilise in this way. The arsenic content would appear to render the entire Ok Tedi toxic both for drinking and for fish as the maximum limit for drinking and the action threshold for fish are **exceeded by three to thirteen** times. Because the arsenic/copper ratio in the particulates in the rivers stands at a value of c. 3%, it is probable that this value is exceeded in the copper ore.⁴¹ In Mexico, mining companies are reported as being unlikely to mine copper ores with a As/Cu ratio of 7% because of the costs of dealing with arsenic's toxicity to the environment.⁴² An investigation of the ground-water in the Ok Tedi and Fly River Region, with particular reference to arsenic content, is therefore needed to clarify the situation as regards this pollutant. As yet, this appears to have been entirely unrecognised.

In order to accelerate the mobilisation process (and conserve the samples), 1 ml of nitric acid (65% supra-pure) was added to the samples of river-water taken at Tabubil Bridge in a 125 ml teflon bottle and the dissolved metal content measured after a period of two months. The pH-value was 1.3 (120 ml distilled water with 1 ml HNO₃, 65%, mixed, has a pH-value of 0.86).

In this almost incredible heavy metal cocktail, 60% of all the elements in the relevant fields of relative atomic mass were present. In mass spectrum, the following values in microgrammes per litre were obtained:

mass spectrum (relative atomic mass)

range	240-190	uranium 10, thorium 3, lead 390, thallium 2
range	140-82	cerium 46, lanthanum 22, barium 215, caesium 4, cadmium 5, silver 3, molybdenum 39, yttrium 26, strontium 2780, rubidium 53
range	79-44	arsenic 20, gallium 15, zinc 850, copper 2270, nickel 166, cobalt 27, iron ca. 80000, manganese c. 4000, chrome 45, vanadium 120, titanium, scandium

A comparison with the analysis of the total metals indicates c. 55% solubility (with the exception of arsenic, 15%, whose compounds are not readily soluble in the acid range). The literature highlights the toxicity of lead (lead encephalopathy for young people) and cadmium (kidney dysfunction for older people). Given that the ancient rock and chat tips of the old Roman lead-zinc mines in Wales still cause environmental problems, which have to be remedied at considerable public expense, it is highly probable that the Ok Tedi mine will continue to be a source of environmental problems several centuries after it has closed down. Because of this concern proper provision ought to be made now by the companies concerned. However, is effective environmental protection possible at all with this type of open-cast mining?

We now turn to the question of the impact of this enormous sedimentary load on sea-water. The redox conditions prevailing in sea-water also lead to a release of heavy metals. When anoxic sediments come into contact with oxic sea-water and its chloride ions, the solubility of metal is raised considerably in the sequence $Cd \gg Cu > Ni$.

A comparison of the two sea-water samples (11 and 10) reveals that the ratio of turbidities 6.1 (turbidity - 0.4 1/m, 0.4 1/m is the average turbidity of coastal waters) is identical with the ratio of iron contents (6.3). That is, almost all the iron is bound to the sediment in the water. However, the cadmium and zinc content, and to a lesser extent the lead content, is independent of the varying amounts of sediment in the water samples! It is not improbable that the entire sea-water of the Gulf of Papua exhibits concentrations in the order of magnitude found in our sea-water samples. (As a consequence, it would be a matter of some urgency to carry out corresponding investigations of the sea-water of the Torres Strait and the northern Great Barrier Reef.) A comparison of these values for Pb (0.011 mg/l), Zn (0.05 mg/l) and Cd (0.0015 mg/l) with the corresponding values measured off the Dutch North Sea coast reveals a level of **pollution** in our samples some **50 times higher for cadmium and lead**, and **10 times higher for zinc**.⁴³ Our measurements were not precise enough to warrant a corresponding comparison for Cu and Hg. In the case of Hg, considerable losses may have occurred in the sample during transportation. It is reasonable to suppose that a corresponding accumulation of lead and cadmium has already taken place in the livers and kidneys of salt-water fish. There is evidence of heavy metal contamination (Cu, Cd) of prawns.⁴⁴ Salt-water in the Gulf of Papua, for example, has a **lead** content c. **400 times** greater, **cadmium** c. **200 times** greater, and **zinc** c. **100 times** greater than concentrations found in open ocean waters. An urgent investigation is also required of the effects of this pollution on the breeding grounds of the silver barramundi (*lates calcarifer*) along the coast. The concentration of total cadmium in our sample taken

from the Middle Fly was at least three times less than the cadmium concentration in the sea-water, whereas the lead content of the river-water was seven times higher. Because the cadmium bound to the river sediment is very rapidly soluble in sea-water, the saturation point of the sea-water may already have been reached, whereas in the case of copper and lead, concentrations can be expected to continue to rise markedly. An investigation of the Strickland River and of old river and marine sediments could throw some additional light on this issue. Such a study would also have to include other major rivers and ocean currents. In the Coral Sea, currents mostly flow westward; however, in January the current along the Great Barrier Reef flows in a south-easterly direction.

Effluents from the Ok Tedi mine might therefore pose a threat to this highly sensitive, and nutrient-poor, eco-system.

The identification of cyanides in the river- and sea-water has contributed to considerable local anxiety in the Fly Region. (The best known is the powerful poison potassium cyanide.) This was occasioned not only by the fish-kills in 1984 and 1985 in the Fly River, but also because of the serious cyanide accident in 1984 in the Gulf of Papua, in which 27,000 kg NaCN sank in the sea. Our measurements of free cyanide in the sea-water near the scene of the accident were below our limit of accuracy in sea-water of 0.005 mg/l. Traces of free cyanide were also found in the Ok Tedi: 0.002 and 0.001 mg/l CN (samples 31 and 41): these probably originated in the ore flotation process. In the Fly River, values were below 0.001 mg/l. That is, the values were in the range of one to two orders of magnitude below the Federal German maximum limit for drinking water of 0.05 mg/l, and the threshold toxicity level for fish of 0.03-0.25 mg/l. However, these findings do not mean that the time-bomb - enough to kill 100 million people - represented by the gradually rusting cyanide containers in the Gulf of Papua has been defused.

The care-free way in which cyanide has been dealt with in environmental terms in Papua New Guinea is evidenced in the 1985 environmental plan drawn up in 1985 for the New Guinea Gold Mine (NGG) in Wau. Up until the closure of the mine in 1990, Renison Goldfield Consolidated Limited (RGC) discharged cyanide effluent from the gold ore leaching process directly into the river, without additional treatment, after the effluent had stood in open basins for three days, lowering the concentration of free cyanide to perhaps 1/5. We were informed that the Bulolo River, for this reason, has long been dead.

A final observation on radioactivity: gamma radiation of c. 0.11 microsievert per hour in the immediate vicinity of the mine lies within the normal range. None the less, radon levels should be measured in the factory buildings.

To conclude, there is good evidence to bear that mining operations at Ok Tedi will initiate long term, that is centuries of ecological, cultural, health and economic damage far exceeding the short term economic gains. The Fly River has begun to show signs of serious and lasting environmental damage, and the sea-water of the Gulf of Papua is heavily polluted. The implementation of the Environment Plan approved by the government of Papua New Guinea by Ok Tedi Mining Ltd. will not contribute to saving the Fly River Region, whose land and culture, economy and population are likely to suffer serious damage, if they survive at all, following thirty years of mining operations of this type. If, it so happens that the food producing capacity of the area for the 25,000 people living on and from the Fly River were to break down, (this possibility cannot be entirely ruled out) forcing the government to provide Kina 3 per person per day to buy food (that is, Kina 27 million per year), then the meagre revenues generated by the mine's operations (Kina 19 million in 1989) would mean that even from this limited short term economic perspective, the project would represent a national loss.

In order to hold pollution levels below a reasonably acceptable maximum, in line with common international standards, the company would have to reduce discharges into the Ok Tedi to a few per cent (c. 2.5%) of their current levels (equivalent to 1.5 million tonnes of waste rock and tailings per year).

Our findings have confirmed what the mining industry in Papua New Guinea already knows only too well. A senior mining official told the authors of the present study: 'Mining in this form would not be allowed either in Australia, the USA, or the rest of the western world'. Might it now be that for Papua New Guinea the blessings of mineral wealth are proving to be a curse?

Chapter IV

Implications for development and environment policy

As we have seen in Chapter II, the Ok Tedi project appears to have fallen far short of fulfilling the hopes originally pinned on it by the government and the people of Papua New Guinea.

Receipts from profits, taxes and royalties are much lower than initially anticipated, and those resources ultimately available to the state from revenues from Ok Tedi for development objectives would appear to be minimal. Recently, even the World Bank has begun to express doubts as to whether this situation will change in the next few years. This realisation seemingly has not weakened its continuing commitment to 'enclave projects' as a vehicle for the development of the country:

*Ok Tedi is not expected to contribute much revenue for another several years because of relatively low productivity, accelerated depreciation provisions, and the recent decision to exempt dividends on its preference shares from tax.*⁴⁵

The employment impact of the mine has been comparatively minor. Few so-called multiplier effects were initially expected, and in reality mining operations have generated barely any economic activity in other sectors or regions of the country. For example, no further fabrication of the mine's products takes place in Papua New Guinea. The vast bulk of cargo for the project is imported. The World Bank has also arrived at a similar conclusion on these issues, although it then consoles itself - in contradiction to its own findings, noted above - with the observation that the main contribution of the mine(s) to national development derives from payments by the mine(s) to the state:

*Government and the mining companies are making efforts to increase the local content of production, but only modest increases can realistically be expected. Most of the consumer goods required by mining company personnel are also imported. For these reasons, the multiplier effect of mineral investments is small. Moreover, mining has only a limited impact on employment . . . Thus, the main benefits provided by the mining sector to the rest of the economy are financial flows rather than direct linkages.*⁴⁶

Most of the newly-created infrastructure is primarily directed at meeting the requirements of the mine, and even when publicly available or useable, is not generally appropriate to the needs of the local population. Few benefits or impulses radiate from this mine-orientated infrastructure to other economic activities in the region, such as agriculture. Offering only scant potential for the development of the region and the country as a whole, the infrastructure created for and around the Ok Tedi project is essentially a reproduction of the classic pattern of fixed investment designed to meet the import and export needs of raw material extraction.

To recap: the Ok Tedi project has contributed neither directly nor indirectly, in contrast to original hopes, towards those national developmental goals proclaimed in 1976 - such as national self-reliance, social justice, and a reduction in foreign dependency - which have not lost their relevance for Papua New Guinea. The Ok Tedi enclave project has also generated major ecological and social problems, and has exposed the natural foundations of life in the region and province to the threat of permanent destruction.

Large-scale projects of this type reinforce the tendency towards regionally- and sectorally-imbalanced development, both at regional and national level. They engender social problems, such as rising unemployment and poverty, criminal and rascal activities by contributing to the destruction of existing social structures and raising unrealistic expectations for jobs, incomes and participation in a modern consumer-society.

The overall modest net receipts accruing to the province, the country and landowners do not adequately compensate for the massive environmental pollution and negative social effects associated with the Ok Tedi project. Should it prove impossible to adequately eliminate the cost element of the extremely high burden on the environment and secure an appropriate participation for the country in the economic gains from the project, then only one recommendation can be plausibly advanced: that mining operations should be stopped without delay, and the project wound up in an orderly fashion.

The conditions which would have to be met to allow the project to continue in a form which would contribute to the long-term development of the country are relatively straightforward:

- Pollution would have to be reduced to prescribed environmentally tolerable levels, in accordance with international standards.
- The province, Papua New Guinea as a whole, and landowners would have to be afforded appropriate participation in the economic gains from

the project to enable it to fulfil its intended role as a vehicle for development.

- The net receipts accruing to the province and central government from the project should be used to pursue the originally proposed national development goals and not, as has happened so far, for financing general public expenditure.
- A programme for the long term economic and social development of the province needs to be developed. In particular, concrete plans must be drawn up in good time for alternative employment for those currently working at the mine in economically sustainable, ecologically acceptable and socially useful projects. The appropriate measures need to be set in train now.

There appear to be only two possibilities through which environmental pollution caused by the direct or indirect discharge of waste rock and tailings into the drainage systems of the Ok Tedi and Fly River can be reduced to an environmentally acceptable level. Either the sedimentary load is for the most part trapped by a dam and a retention basin, or mining operations are reduced to a level at which volumes of sediment discharged into the rivers no longer constitute an environmental hazard.

According to the company, a dam and a basin could intercept up to 90% of sedimentary discharges. As yet, however, the company has refused to build the dam on the grounds that construction costs would be in the order of Kina 1 billion, and that no absolute guarantee could be given that such a dam could withstand a landslide or an earthquake. Other estimates have put construction costs at US\$130-300 million.⁴⁷ Therefore, it is a matter of some urgency to draw on independent international engineering consultancy advice to judge whether a landslide- and an earthquake-proof dam can be built. If this is found to be possible, construction should begin immediately, and be completed within as rapid a period as is technically possible. And this task should be made an irrevocable condition for the continuation of the project.

If Ok Tedi Mining Limited were to refuse to accept this condition, subject to its technical feasibility, an immediate cessation of mining operations would be advisable, accompanied by approaches to other companies to explore whether an operator could be found willing to run the project on the condition that a dam and a basin be built. It is not inconceivable that operating companies from Korea, Taiwan or China could be found who would continue the project under conditions which are environmentally acceptable for Papua New Guinea.

However, if it should emerge that it is impossible to construct a landslide- or an earthquake-proof dam, there would be no other alternative but to suspend mining operations. Because as we see it, a reduction of direct discharges and washout from the mine into the river systems to an environmentally acceptable level (in our estimation, to some 2.5% of current volumes!) would effectively warrant a halt to production. *Roger J. Higgins*, Ok Tedi Mining Limited's own environment expert, has himself commented:

Mining activity results in movement of rock and earth with three dominant environmental consequences. Material is available for erosion, increasing the sediment load of mine-area streams. This effect is greatest for high tonnage, open-pit mines, where large areas of ground surface are disturbed and rock below cutoff grade is moved to overburden dumps. Where erosion is uncontrolled or difficult to control, the sediments themselves can present an environmental hazard irrespective of their mineralogical composition. Because material exposed to erosion is likely to be mineralised, a further hazard is presented by the potential for heavy metals to be released into solutions from sediments, either in the vicinity of the source or at some downstream depositional environment

A further significant environment consequence of mining activity, whether surface or underground, is interference with natural groundwater tables and in-situ permeability. This frequently releases groundwater to surface streams, although diversion of surface water to groundwater can also occur. In either case, drainage from mineralized

rock can result in contamination of receiving waters with high concentrations of metals in solution.

The highest volume discharge from a mineral processing plant is the tailing, incorporating finely ground ore from which the economic minerals have been removed. The proportion of metal recovered can be extremely small . . . Sand- and silt-sized materials in the tailing may present environmental hazards both as sediment and as a further source of heavy metals.

If severe impacts are observed or if environmental monitoring suggests that they are likely, then two steps follow. Immediate action is required to remove or suppress the cause of the impact; this may involve such actions as diversion of effluent discharges to a holding area for treatment, reduction of processing throughput rates or in extreme cases the temporary suspension of operations. These immediate steps are taken until such time as conditions stabilize or until revised operating procedures can be designed and implemented so that the observed severe impacts are mitigated or avoided.⁴⁸

What would appropriate participation in the economic gains from the mine entail? What is not acceptable is the observation on the part of the World Bank - almost cynical given the disputed profitability of the mine - that Ok Tedi is unlikely to contribute much revenue to the state for several years. It was precisely the prospect of such revenues which was originally used to legitimate Ok Tedi and other mining projects (the 'vehicle role!'). The fact that not only the whole output of the mine, copper concentrate, is shipped out of the country, but in addition the vast bulk of its earnings constitutes a profound failure on the part of this enclave project to fulfil its intended role in national development. Appropriate participation in the economic gains from the mine would require that at least half the revenues from the mine should remain in Papua New Guinea in the future and accrue to the state in the form of dividends, taxes and royalties.

The hoped-for developmental function of enclave projects will, however, only be fully realised if receipts are in practice put to use for the development of the country in accordance with proclaimed goals.

What form of development would be appropriate for the Ok Tedi Region or the Western Province of Papua New Guinea is a matter best left to the people themselves. Given that the modern world of goods and technology has now irrevocably penetrated the region, the issue is now to lay down the prerequisites for a socially-useful, ecologically defensible, and a relatively balanced and well integrated pattern of agricultural, artisan and industrial production orientated to the domestic market. For example, the province's natural endowment would lend itself to the cultivation and processing of rice or commercial fishing and fish-processing.

The prerequisites for these and other activities include the extension of transport facilities, the establishment of local and regional markets, the organisation of marketing and supplier cooperatives, the creation of facilities for the preservation and independent development of regional cultural traditions, technologies and techniques of production and cultivation, the expansion of health and education services, and the foundation of organisations to protect the environment.

The Ok Tedi/Fly River Development Trust, recently established by the mining company, which provides an annual sum of Kina 2.5 million for village development, including communal village facilities, and for the promotion of agriculture and industry, may mark one step in the right direction. However, more is required than the isolated projects promoted by the mine, which also fulfil a useful public relations role. The population of the region and province has a legitimate claim that a portion of the receipts which are due to the country from the mine's revenues should be used, systematically and continuously, for the creation of facilities, such as those listed above, which open up developmental options.

Finally, it might now be appropriate to bring forward ideas and conceptions for economic activities which can be developed in the region after the mine has ceased operations - whether this is sooner (on environmental grounds) or later (when the deposits are exhausted in about 15 years). Concrete plans, which must be submitted for discussion and approval at regional and provincial level, need to be developed for types of economic activity which are sustainable, ecologically acceptable, and able to provide employment and income to the mine's industrial labour force, and make use of the infrastructure created to service the mine.

The industrially-trained workforce at the mine represents an economic opportunity for the region. Specific regional conditions, such as climate and geography, by no means imply that industrial activities other than mining are excluded from the outset. For example, the region's specific geographical conditions would facilitate, rather than obstruct, the establishment of a shipbuilding and repair industry. Papua New Guinea has a growing need for such a capacity. It is entirely conceivable that an economically viable industry for shipbuilding and repair could develop in the region capable of meeting an important national market. What is vital, however, is that the perspectives for such future replacement industries for mining are elaborated and undertaken now.

To conclude: further operation of the Ok Tedi mine can only be made environmentally acceptable if the pollution originating from the mine is reduced to a level at which no further lasting damage to the natural foundations of life can occur. And it can only be defended as a component of development policy if the proportion of revenues from the production and export of copper concentrate due to the country and available for developmental objectives is increased to a level which allows the project to fulfil its originally intended national role. Otherwise, there are grounds for fearing that the World Bank's prognosis of a few years ago, intended in quite a different vein, could prove to be fatally prescient: 'Ok Tedi . . . will have an impact similar to that of the Bougainville mine'.

Chapter V

Papua New Guinea's developmental model in crisis

By the late-1980s, what had appeared for some fifteen years as the successful strategy of achieving sustainable economic growth through mineral and agricultural raw-material production and export ran into a crisis.

Papua New Guinea's Gross Domestic Product fell in 1989 and during the first half of 1990. Gross investment in plant and equipment is also falling. Employment in the 'formal sector' has declined. Agricultural output is stagnant. The budget deficit has increased, and foreign indebtedness has grown.

These developments are frequently attributed solely to the interruption and ultimate cessation of mining and plantation activities on

Bougainville. The militant conflicts between landowners and the independence movement on the one hand, and the mine (Bougainville Copper Limited) and the central government on the other are purported to be exceptional events, unrelated to the model of development being pursued in the country. However, the very opposite is the case.

The actions taken by landowners on Bougainville, culminating in a call for secession, are paramountly a protest against the effects of the developmental model practised by Papua New Guinea which, although granting several years of substantial economic growth from mining and plantations, has done so at the cost of an extremely unequal participation in economic activities. Thus creating a highly unequal distribution of the derived economic benefits, and the advancing destruction of the natural foundations of life on the island.

The model of development pursued in Papua New Guinea had progressed further on Bougainville than elsewhere in the country, and as a consequence also came up against its limits earlier. Subsequently the 'Bougainville Crisis' is not some secondary symptom of the process of development in Papua New Guinea: it is a direct expression of the crisis of the model which has been pursued since national independence.

Gross domestic product, investment, employment

Between 1975 and 1988, Papua New Guinea's GDP (at current prices) rose from Kina 1,004 million to Kina 3,092 million, equivalent to a real increase (at 1985 prices) from Kina 1,941 million (1975) to Kina 2,716 million (1988).⁴⁹ According to the World Bank, per capita income in 1988 was US\$ 810 (the same as in 1980), putting Papua New Guinea in the group of 'middle income countries' on the United Nations classification.⁵⁰

The average annual rate of GDP growth ran at 1.5% between 1975 and 1980, and 3.1% between 1980 and 1988. Per capita GDP fell by 1.2% a year between 1975 and 1980, but then rose by an average 0.5% a year

in the period 1980-1988.⁵¹ Measured in terms of per capita GDP, Papua New Guinea did slightly better than the developing countries as a whole, which experienced an annual fall in per capita GDP of on average 0.1% between 1980 and 1988.⁵²

However, the growth in per capita GDP in Papua New Guinea was associated with an increasingly unequal distribution of income, implying a lower per capita income and worsening overall living situation for some groups.

According to the Bank of Papua New Guinea, in 1989 there was a real fall in GDP of 1.5% compared with the previous year which primarily reflected the drop in mining output of 36.7% as a result of the closing of the Bougainville Copper Mine in May 1989. However, the growth rate of agricultural output (in the 'formal sector') also fell from 4.8% in 1988 to 1.3% in 1989.⁵³ This negative trend continued during the first six months of 1990. Provisional figures suggest a further drop in GDP, triggered principally by a fall in agricultural production leading to a noticeable drop in real incomes in the rural sector.⁵⁴

Growth rates of gross investment in plant and equipment fell from an annual average of 1.4% in period 1965-1980 to -1.5% between 1980 and 1988.⁵⁵ (See appendix 3) One cause for particular concern is the marked fall in both private investment outside the mining sector as well as in public investment during the 1980s. In 1987 public investment was 10% lower than in 1980 and private investment outside the mining sector fell by 20% over the same period.⁵⁶

The labour force (persons of working age) rose from 1,400,000 in 1975 to 1,540,000 in 1980, and about 1,800,000 by 1988 (out of a total population of 3,700,000 in 1988). The number of employees in the 'formal sector' (employed under typical conditions of waged employment) increased from 158,000 in 1975 to around 200,000 in 1980, and 270,000 in 1988.⁵⁷

The 'formal sector' thus offers employment to around 15% of the labour force. Approximately one third of the working population works as smallholders in cash-crop agriculture, with broadly the same proportion in subsistence agriculture. The remainder, for the most part, are unemployed. Of those employees in the 'formal sector', 19% (51,000) worked in the public sector in 1988. Mining employs directly only 7-8% of those employed in the 'formal sector' (15-20,000 employees), and hence only 1% of the total population of working age.

The labour force is currently growing by 50-60,000 people a year.⁵⁸ Although the majority will remain in the agricultural sector (both subsistence and small-scale cash-crop production), a growing number of workers will be pushed into the 'formal sector': however, only a fraction will find employment. Unemployment continues to grow, especially in the towns. Some 17% of the total labour force is currently estimated to be unemployed with the rate of unemployment in urban areas put at around 25%.⁵⁹

Whilst there was some increase in employment in the 'formal sector' during the first half of 1989, the second half of that year and the first nine months of 1990 saw a noticeable drop in 'formal sector' employment, including employment outside of mining. According to the Bank of Papua New Guinea, employment in the 'formal sector' (excluding mining) fell by almost 8% between September 1989 and September 1990. The drop was particularly marked in commerce, construction and agriculture and forestry.⁶⁰ Overall, the employment situation in Papua New Guinea worsened markedly during the 1980s.

Agriculture and forestry

Agriculture continues to constitute the economic backbone of Papua New Guinea - for a number of reasons.

In the first place, around one-third of GDP is created within agriculture. Far from falling, the share of GDP accounted for by agriculture rose from 28% in 1975 to 34% in 1988. The bulk of the population continues to find its livelihood in agriculture: approximately 85% of the population lives in the rural sector. The current forms of the ownership of land provide an important source of economic and social security and political stability: around 97% of the total land area, and 90% of agriculturally used land, are in communal village ownership (clans). Some 50% of agricultural production is accounted for by the production of food, in the form of both meat and food-crops, for domestic consumption; 75% of food is produced in the subsistence sector. Moreover, agriculture is also an important pillar of the country's export economy. Around 35% of export earnings come from the sale of agricultural products, primarily coffee, cocoa, copra and oil palm.

Agriculture is dominated by smallholder production, most of which is mixed farming for immediate consumption (subsistence) and for the market (cash crops). The government estimates that more than 60% of all agricultural subsistence farms (families) are also engaged in commercially-orientated agriculture.

Small-scale mixed farming for subsistence and sale, in part carried out on the basis of communal labour, is highly adapted to local natural conditions and constitutes only a minor threat to the natural environment compared with capital-intensive large-scale agriculture. Moreover, this form of small-scale agriculture is also both economically efficient and often superior to plantation production when measured in terms of costs per yield.⁶¹

Smallholders account for approximately 70% of coffee and cocoa production, 60% of the production of copra, and 50% of the production of oil palm.

However, agricultural development in Papua New Guinea is threatened by a number of problems. Food production has not kept pace with population growth. The World Bank sets the index of per capita food production for 1986/88 and for 1987 in comparison to 1979/81 at 97.3 (1987)⁶² and 92.0 (1986/88) respectively.⁶³ In particular, the cultivation of traditional products such as yams, taro and sago, some of which have been displaced by imported foods, has fallen. Although, fortunately, there is not as yet hunger and undernourishment in Papua New Guinea. The proportion of demand met by local production has fallen markedly, with a worrying rise in dependency on imported foodstuffs. Food imports currently account for around 20% of total imports.

The drop in prices on the world-market for coffee and cocoa over the last two to three years has caused a stagnation and fall in output of these export products and a noticeable decline in rural incomes. Because the price stabilisation funds for coffee and cocoa have exhausted their resources, they can no longer fulfil their buffer role and compensate producers for falling prices unless new public contributions can be expected.

Moreover, neglect of the rural infrastructure, and in particular that needed for transporting, storing and marketing agricultural products, has imposed constraints on raising food output for the domestic market and cash-crop production for export. In their 1982 report, the World Bank bluntly set out the inadequacy of public investment in rural infrastructure:

*Agriculture will not grow rapidly given the present level of support services for smallholders and the uncertainty that has dampened investments on estates. . . . Government spending will be restricted during the next few years by the declining real levels of Australian aid, the relatively small tax base, and the declining copper prices and output from the Bougainville mine, which supplies a substantial proportion of government revenue.*⁶⁴

Agricultural development is also increasingly threatened by ecologically misdirected developments, and especially the transformation, use and destruction of the natural environment by non-agricultural activities, the prime examples of which are mining and tree felling, both undertaken for export. Most endangered by the direct and indirect consequences of these activities, the gravest of which are the partial and in some areas total destruction of rain-forest, is smallholder mixed farming for subsistence and cash-crop production based on common ownership of the land - the very system of agricultural production which has shown itself to be both ecologically sustainable and economically viable.

As we saw in Chapter III, the effects of mining on the natural environment are not confined to the fact that land is used up directly for mining activity, although this can be very significant in the case of open-cast operations. The direct and indirect discharge of waste rock, tailings and materials used in the production process into the river systems of tropical rain-forest areas, as is taking place on an increasing scale in Papua New Guinea, has more extensive and serious consequences for the environment, and hence often too for agriculture. Such materials can impair agriculture in the floodplains of river systems for hundreds of kilometres, or even cripple it totally.

Both traditional subsistence and mixed farming for cash-crops and subsistence livelihood in the forest areas cannot survive without the 'protection of the forest'. The disappearance of the forest will lead directly to erosion, wash-out of the humus layer, and finally the impoverishment of the increasingly sandy soil. Such deficient soils, which in addition are often enormously compressed by the weight of tree-felling machinery, are unlikely to recover sufficiently to support agriculture for decades and possibly for centuries.

A formerly wooded, and now cleared area, in Papua New Guinea, the Gogol Valley in Madang Province, has provided disturbing evidence of this. The Japanese paper company Honshu acquired a concession for

falling in this area before national independence over an area of 52,265 hectares. In 1973, a subsidiary of Honshu, the Japan and New Guinea Timber Company Ltd. (JANT) began felling using the clear cutting method. The timber was converted into chips on the spot in a process developed by Honshu and exported to form the raw material for packaging and cartons. On average 2,000 tonnes of chips were produced and shipped to Japan, requiring the clearing of 3,000 to 4,000 hectares a year. By 1984, 37,000 hectares of forest were completely cleared. Since JANT, in breach of the contract, has delayed in re-afforestation, the state has only provided for the meagre re-afforestation of a total of 5,000 hectares. Although there were protests by landowners, who had only ceded their rights to the government for selective, not total, felling, the company succeeded in obtaining an additional concession for felling in a region adjoining the Gogol Valley.⁶⁵ However, landowners are no longer prepared to accommodate this development without resistance and accept the total destruction of their country for an, as yet, laughably small financial compensation. They are now demanding that JANT pay Kina 17 million in compensation, that the company's felling concession be withdrawn and transferred to landowners, and that JANT should leave the country.⁶⁶

The rain-forests of Papua New Guinea form one of the few remaining extensive forested areas in the South East Asia/South Pacific region. The unscrupulous and uncontrolled felling of the rain-forest, which may now be beyond the control of the government, is increasingly taking place in many parts of the country.

According to two reports by public organisations,⁶⁷ with concurring conclusions, there is no regulated form of forestry in Papua New Guinea. Guidelines on felling are ignored and existing obligations for re-afforestation are disregarded. The timber trade is beset by corruption and mismanagement.⁶⁸ Although the bulk of the rain-forest is still intact, its fate would be sealed if the practice of uncurbed felling for commercial forestry were to take a hold in Papua New Guinea. And the disappearance of the rain-forest would also mean the end of agriculture in rain-forest areas which provides the majority of the population with its livelihood.

Of Papua New Guinea's total land area of 46.2 million hectares, some 78% (36.2 million hectares) are forested. Around 15 million hectares are deemed suitable for commercial forestry. Of this, 6 million hectares, 40%, are currently accessible, and offer the prospect of profitable felling. (All the above figures are taken from the World Bank report). Based on an assumed annual timber yield of 30 m³ per hectare and a regeneration period of 50 years, the World Bank considers that commercial forestry taking 3.6 million m³ a year would be reasonable, corresponding to the annual felling of 120,000 hectares. The government's development plan from 1990 goes as far as proposing 6 million m³ a year, the equivalent of an annual felling of 200,000 hectares. However, all these calculations and plans ignore the fact that the rain-forest is used for agriculture - including, naturally, those areas 'accessible for forestry'. The use of the rain-forest for commercial felling (including 'selective' felling, which also destroys the rain-forest) not only therefore has devastating ecological but also far-reaching economic and social implications. It renders the land unusable for agriculture: its inhabitants lose the basis for their livelihoods and are often forced to migrate - into unemployment and poverty.

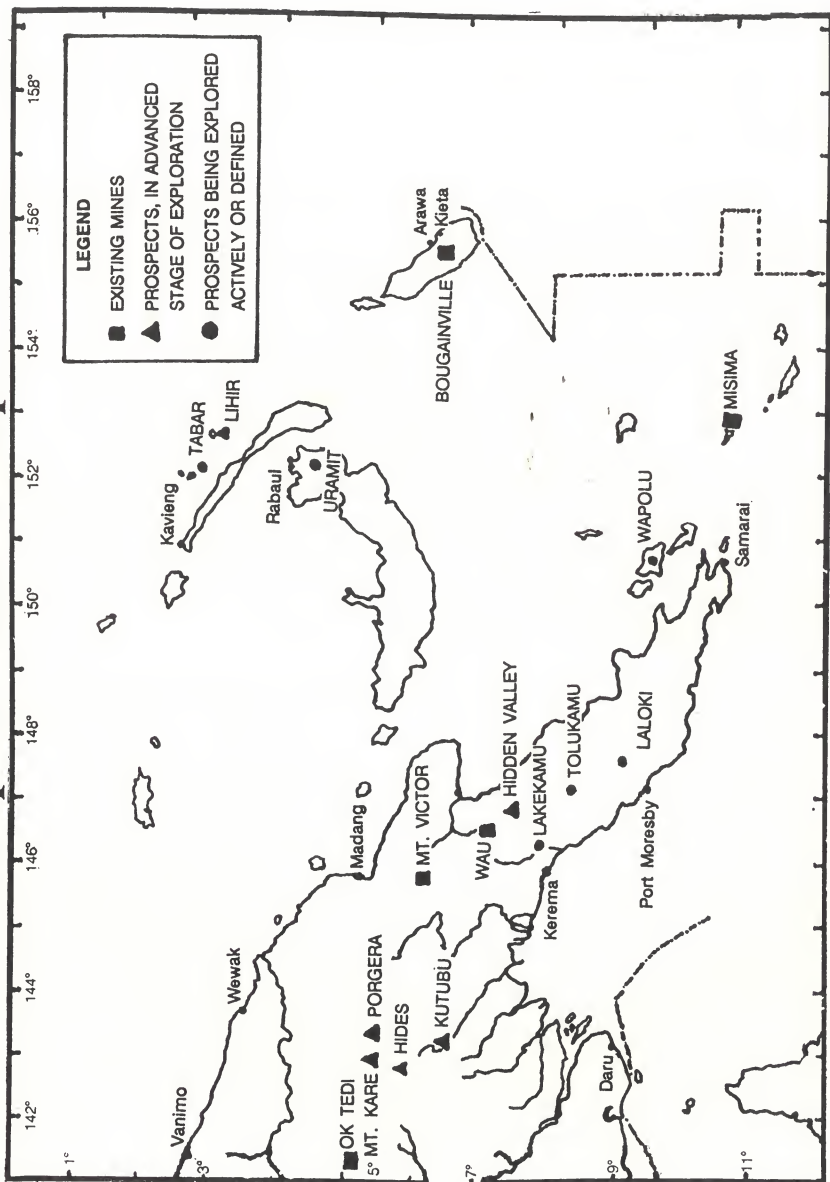
In recent years, approximately 2 million m³ of round timber has been taken through felling each year, of which 1.2-1.4 million m³ have been exported. Between 1980 and 1989 a total of 11.3 million m³ have been exported. Commercial forestry is estimated to have been responsible for the annual destruction of 80,000 hectares of rain-forest (uncontrolled felling). Even though large tracts of rain-forest are still intact, the full consequences of the felling undertaken so far are incalculable. This does not only apply to wholly cleared areas, such as in Madang. The destruction of the forest is also far advanced at many individual locations in the country, such as the Bamu Region in the Western Province. Currently, felling of round timber for export is taking place in 19 of Papua New Guinea's provinces. Eighty per cent of the rain-forest has disappeared in the province of New Ireland. Should commercial felling go ahead on a scale

several times greater than previously practised, something which the World Bank regards as reasonable, then even if carried out on a 'controlled basis' (as yet not the case), catastrophic ecological, economic and social consequences would appear to be a foregone conclusion.

According to a circular from the Australia-New Zealand-Pacific Association, based in Hamburg, in 1989 one single concern, the Japanese-controlled Stettin Bay Lumber Corporation obtained the concession for felling on 420,000 hectares in the provinces of West and East New Britain. Within 20 years, 7.3 million m³ of timber is to be felled. Total investments of Kina 175 million are planned for a saw-mill, wood-chip factory and veneer plant; Kina 20 million will be made available for re-forestation. The same circular notes that standing timber in the Kikori Region (Gulf Province) will be used over the next seventeen years by the Long Term Trading Company.⁶⁹ It has also already been apparently decided that the last remaining reserves on New Ireland (Lak Region) are to be made available for felling.⁷⁰

The National Forestry Development Program published by the Forestry Department in 1988 envisages the granting of concessions for felling on a total area of 4.8 million hectares for the period 1988-1991 ('The Forestry Sector: A Tropical Forestry Action Plan Review'). In mid-1990, the Forestry Department had received 28 applications for the granting of concessions for felling on an area of 3 million hectares.⁷¹ The decision by the Minister for Forest and Environment not to grant further concessions from July 1990 for a period of two years is misleading in that existing negotiations are excluded from the moratorium. The Times of Papua New Guinea commented bitterly: 'Logs make money, money wins votes'.

Prospect location map



Mining

In 1988, Papua New Guinea's mining sector accounted for 15% of GDP, 60% of exports, and 1% of employment.

The closing of the gold and copper mine on Bougainville in May 1989 (the first and until then the largest mine in the country, and one of the largest copper mines in the world), and its consequent loss of output, exports and revenues, was the trigger for the acute economic and political crisis in Papua New Guinea. The shutdown was preceded by the escalating conflicts between the landowners, who had lost their land because of the mine's operations and regarded themselves as cheated out of fair compensation by the mining company and the government. As for the company (Bougainville Copper Limited) and the government, both regarded themselves as confronted by astronomic, and barely fulfillable demands for compensation (Kina 6 billion). At the same time, the confrontations about the mine's operations revealed the massive ecological, economic and social difficulties caused by mining practises in Papua New Guinea, in which environmental and social considerations were largely disregarded.

Eighteen months later, in early-1991, it appeared as if the continuing dynamic of the mining sector might have put Papua New Guinea back on the road to economic growth, despite the Bougainville crisis. However, whether this will mitigate the crisis of the currently practised model of development, that is the wide-reaching economic-ecological and social-political crisis of the country, is an entirely different story.

During 1990 Ok Tedi, so far the second largest and currently the only operating gold and copper mine in Papua New Guinea, reached its maximum rate of capacity utilisation and has since been producing at full volume. The same applies to the Misima Goldmine (Misima Mines Limited, Misima Island, Milne Bay Province), which did not begin production until

May 1989 (the month that the Bougainville mine was closed). A second gold-mine, Porgera Goldmine Limited (Enga Province), began gold production in August 1990. Progress is well advanced on the opening up of two other mines, Lihir (Lihir Island, New Ireland Province) and Hidden Valley (Wau Region). Other gold-mine projects, such as Lakekamu (Gulf Province), Tabar (New Ireland Province) and Urमित/Wild Dog (East New Britain) are still being prospected. By the end of 1989, 137 prospecting concessions had been granted, covering 20% of Papua New Guinea's land area.⁷²

The first oil production in Papua New Guinea is scheduled to begin in 1992 in the Lake Kutubu area (Southern Highlands). A consortium led by the US Chevron Corporation has recently obtained a licence for production in this region. By the end of 1989, 60 companies (almost without exception foreign) had obtained 38 licences for oil prospecting in areas with a total land area of 230,000 km².⁷³

It appears as if the same negligent attitude, even indifferent, approach to environmental and social matters which characterised operations at Bougainville, and continues to apply at Ok Tedi, is also being extended to these projects. Nothing is essentially changed by the fact that the companies and the government have shown a willingness to be more conciliatory in negotiations on land-use rights and compensation payments. And also to offer local provincial administrations, who effectively have the final say on whether permission is granted for projects at local level, somewhat higher financial participation. The predictable environmental and social consequences of the new projects will only become evident once production has started, and their full extent will not be revealed until after several years of operations. Once again, the realisation that slightly more generous compensation payments cannot make up for the loss of the foundations of life and the destruction of social structures will probably only dawn on the people when it is too late to take practical measures to redress the damage.

The Bougainville crisis ought to have provided an unambiguous warning. For years, there was an unwillingness to take serious heed of the environmental damage and social problems created by this project and there is still some resistance to the view that the conflicts on Bougainville were directly precipitated by the project. As late as 1988, one year before the unavoidable closure of the mine as a result of the clashes, the World Bank praised the mine as a highly successful project and forecast twelve more years of production.

*BCL operates the Panguna copper/gold mine on Bougainville in North Solomons Province. The mine has been an extremely successful venture. BCL is a low cost producer well able to compete with other copper producers worldwide The mine is at a mid-life stage with about twelve years of economically recoverable, proven ore reserves remaining given present technology, production levels and expected prices.*⁷⁴

However, the fact that the mine was a 'low cost producer' was anything but coincidental. One method used to contain costs was a failure to devote adequate funds to environmental protection and for the establishment of an alternative economic basis for those displaced by the project. The highly-regarded business information organisation, the Economist Intelligence Unit, noted in a research report on copper-exporting countries:

*At Bougainville, the waste and tailings have been released into the Jaba river system on the West of Bougainville island for the whole of 17 years of the mine's operations. This has caused major ecological change and required the relocation of villages. The government has, however, supported the company's operations and has not attempted to enforce unfeasible environmental standards.*⁷⁵

No reason is cited as to why standards should be 'unfeasible'. Local inhabitants in the region were sceptical from the outset and evidently felt that if environmental standards could not be enforced then the whole project would be best left undeveloped.

*For all the benefits the mine has brought, local people were not enthusiastic at the start and are not now.*⁷⁶

What advantages have the inhabitants of Bougainville gained from the project? How much of the revenues accrued to them? Handelsblatt noted:

*[The residents of Bougainville] received a mere Kina 24.2 million from the government's share in the mine out of the total profit of Kina 1,754 billion earned between 1972 and 1989.*⁷⁷

The uprising on Bougainville is therefore primarily a revolt against the further destruction of nature and further financial double-dealing. It is a protest against a model of growth and development based on raw-material production for the world-market at competitive costs irrespective of the cost to the physical and social environment.

This model for growth and development based on raw material production for the world-market at the expense of its social and natural environment in order to maximise, but unequally distribute, financial returns was not the only determining factor of events on Bougainville. From its inception to the provisional end of the project, this model was the guiding principle behind its operations. This again is the model currently followed by Ok Tedi and behind the new mining projects - as if the Bougainville crisis had never happened.

Misima Mine Limited, 80% owned by Placer Pacific with the remaining 20% owned by the state (Mineral Resources Development Corporation), is discharging tailings (and possibly also cyanide effluent from the leaching of gold ores) from the processing of 15,000 tonnes of ore per day and the production of 6,000 kilos of gold and 40-100 tonnes of silver per year directly into the sea via a pipeline which ends 100 metres below sea-level at a point on the sea-bed where the sea-floor drops away steeply by up to 1,500 metres. The mining company and government evidently

regard topography as guarantee that such forms of disposal are ecologically safe.

The Porgera Goldmine, in which Placer Pacific (the operating company), Renison Goldfields Consolidated and Highlands Gold Properties each have a 30% stake, with the state holding 10%, is currently mining gold ore underground and will shortly begin opencast operations. With a proposed gold output of, on average, 20 tonnes a year and a daily ore-extraction of 3,000 tonnes by underground operations and 4,500 tonnes from strip-mining, all the tailings (and probably other process wastes) are to be discharged into the river system of the Strickland River, a tributary of the Fly River. This will not only produce environmental damage in the Strickland River basin and in Lake Murray over a distance of several hundred kilometres but also increase pollution in the lower reaches of the Fly River and ultimately the Gulf of Papua.

Compensation provisions are as follows. For the use of the land, the mining company will pay clans entitled to compensation the sum of Kina 5 per hectare per year. For land which will become unusable but could be 'rehabilitated', compensation will equal Kina 22.50 per hectare, with Kina 40 per hectare paid for irreversibly destroyed land. In 1990, the mining company paid Kina 53,397 in fees for land-use - equivalent to the utilisation of more than 10,000 hectares. So far Porgera has paid Kina 207,000 for the destruction of gardens and garden land as a result of the dumping of rock-waste in the Anawe Creek whilst opening up strip-mines ('the banks of the Creek once served as good garden-land for the people'), from which it can be inferred that more than 5,000 hectares of former agricultural land has been destroyed.⁷⁸

The Lihir Mine, still being developed, which is 80%-owned by Kennecott (RTZ) and 20% by Niugini Mining, will have a capacity to process 10,000 tonnes of gold ore a day and in addition produce sulphur.

Mining wastes will be discharged into the sea via a pipeline, with rock-waste dumped directly into the sea.

There are no indications that other projects still in the exploration stage, such as Hidden Valley (CRA), Lakekamu (City Resources, Lydgate Holdings), Tabar (Kennecott, Nord Australex Nominees, Niugini Mining) and Wild Dog (Highlands Gold Properties) will adopt a different approach to that of containing costs by damaging the social and physical environment.⁷⁹

Worrying ecological and social developments also seem to be emerging during the development of the oil-fields. The recent protest of one group of landowners in Poroma, Southern Highlands, provides some clear evidence.

*The landowners have initiated proceedings against the Chevron company at the competent court for illegally constructing a road for heavy trucks on the course of a road built by local people and used by them for the previous twenty years, for illegal use of land for extending the road, and for the illegal destruction of property. The landowners are demanding a lump-sum of Kina 648,000 from Chevron in compensation, and the payment of user fees for the land of Kina 1,000 per hectare. When no representatives of Chevron appeared at the court at the proper time, the landowners resorted to a blockade of the access road to the Chevron depot. The dispute remains unresolved.*⁸⁰

'Have we learned anything from Bougainville?', asked *Sir Barry Holloway*, long-served member of Parliament, former Finance Minister and respected national politician in a letter to the Times of Papua New Guinea. He supplied the answer himself: 'It's my impression that we are repeating all the mistakes, not only with one of the projects but with all of them'.⁸¹

Since mining projects in Papua New Guinea are generally associated with high capital outlays, and nearly all are largely financed by foreign loans, and almost all the equipment, spares and process materials have to be imported, the new projects will provide a renewed

demonstration of the fact that, despite substantial increases in production and exports, the economic situation of the country will scarcely improve overall, and at best only locally, and that the hoped-for development effects will not materialise. Not only will a large slice of the receipts have to be spent on debt-service, but in addition a considerable proportion of the export-earnings will go to meet higher imports. The direct and indirect employment effects will be meagre. The consumption of resources will increase enormously.

Once all the new projects come on stream, as planned, the consequences for social and political development are likely to be grave. More and more people in the affected regions will discover that compensation is no substitute for the ruin of the foundations of their existence and opens up no alternative developmental perspectives. There are good grounds for fearing the creation of 'one, two, many' Bougainvilles.

Public finance, external debt

The central government's budget moved substantially into deficit during the 1980s, with a worrying increase in public debt. Debt-service currently takes more than 20% of public revenues each year. The budget estimates for 1990 envisage revenues of Kina 923 million and spending of Kina 1,250 million. The government intends to cover the excess spending of Kina 327 by grants from abroad of Kina 183 million, including Kina 172 million from Australia. The remaining Kina 144 million deficit will be financed by new borrowing, primarily from abroad.⁸² (See appendix 4)

A total of Kina 239 million flowed into the fund from gold and copper mining at Bougainville between 1981 and 1987. During this period, the government was able to record budgetary revenues of Kina 279 million from the fund. Over the same period, public debt rose by Kina 696 million, requiring a total of Kina 639 million to be made available for interest payments alone between 1981 and 1987.⁸³ Public revenues from the

mining sector would not even have sufficed to cover half the interest due during this period. (See appendix 5)

During the 1980s transfers of funds to the provincial governments the funds have not kept pace with the growth in the overall budget. Between 1983 and 1989 it increased only slightly, and not at all in real terms. Expenditure on social services and infrastructure has barely grown in nominal terms, and fell in real terms.

Central government expenditure in selected areas
(Kina millions)

	1985	1986	1987	1988
Economy	58	73	91	80
Infrastructure	110	143	123	117
Social services	106	107	109	107
Justice and internal security	98	107	112	113
Public administration	87	86	97	100

Source: Government of Papua New Guinea, Minister for Finance and Planning, Economic Policies, Vol. II, Statistical Appendix.

Public debt rose almost threefold from Kina 480 million to Kina 1,380 between 1980 and 1990. Of particular concern is the fact that the proportion of external debt has risen to almost three-quarters of the total (Kina 1,015 million), entailing the consumption of a substantial share of foreign currency earnings in debt-service payments.

Public indebtedness

(Kina millions)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990*
Internal debt	176	154	160	166	182	194	233	249	304	368	365
External debt	304	390	486	685	740	879	942	992	881	838	1015
Total	480	544	646	851	922	1073	1175	1241	1185	1206	1380

* September 1990

Source: Bank of Papua New Guinea, Quarterly Economic Review, December 1988, p. S28 and September 1990, p. S28.

As the figures show, debt rose swiftly during the first half of the 1980s. In 1988, a slight fall was achieved. The World Bank warned even then: 'However, servicing the large government commercial debt contracted in the early 1980s will continue to burden the budget for several years to come'.⁸⁴ One year later, in 1989, an increase in debt was recorded, and debt rose markedly in 1990.

Total foreign indebtedness (public and private) climbed fourfold during the 1980s. Whereas debt-growth was relatively modest between 1975 and 1980 (from US\$ 506 to US\$ 649), it increased more than threefold over the next four years to reach US\$ 2,061 by 1984. (About 60% of the increase in debt during this period was for the private sector, with the bulk representing loans to finance Ok Tedi construction.)⁸⁵ External debt was put at US\$ 2,453 in 1988. Both public and private external debt will have grown by no small margin during 1989 and 1990. With an external debt/GDP ratio of 66% in 1988, Papua New Guinea is amongst the world's most-indebted countries. In 1980, the debt ratio was still less than 25%. (In 1988, the average external debt/GDP ratio for

developing countries was 35.2% according to the International Monetary Fund, with 26.2% for developing countries in Asia and the Pacific Region and 96.5% for primarily raw-material exporting developing countries.)⁸⁶ In 1985/86, debt-service accounted for 46% of the sum of exports of goods and services. In 1988 the debt-service ratio stood at 38.5%.

The debt-service ratio for 1988 is around double, and the interest payment ratio (interest payments/visible plus invisible exports) a third, higher than the average for all developing countries. According to the International Monetary Fund, the average developing country debt-service ratio in that year was 19.4% and interest payment ratio 9.5%.⁸⁷ Between 1980 and 1988, Papua New Guinea's debt-service payments totalled US\$ 2,708 million, of which interest payments accounted for a full US\$ 1,255 million. The total receipts from the export of copper concentrate in 1988 of Kina 447 million (US\$ 540 million) would not have sufficed to finance that same year's debt-service payments of US\$ 572 million.

That Papua New Guinea is well on its way to falling into the 'debt trap' can perhaps be best illustrated by a comparison with Brazil, the most highly indebted country in absolute terms in the Third World (all figures for 1988).

External debt and debt-service of Brazil

	1980	1981	1982	1983	1984	1985	1986	1987	1988
External debt (total) (Mill. US\$)	649	977	1231	2156	2061	2242	2395	2691	2453
Debt ratio ¹ (in per cent)	22.5	36.4	48.5	88.0	85.0	94.5	89.4	83.6	65.6
Debt-service (total) (Mill. US\$)	..	..	160	150	303	472	545	506	572
Amortisation (Mill. US\$)	..	..	42	50	89	266	342	355	378
Interest (Mill. US\$)	30*	46*	113	98	214	206	203	151	194
Exports of goods and services (Mill. US\$)	1133	972	928	948	1007	1029	1194	1351	1484
Debt-service ratio ² (in per cent)	..	..	17.2	15.8	30.1	45.9	45.6	37.5	38.5
Interest payment ratio ³ (in per cent)	..	..	12.2	10.3	21.3	20.0	17.0	11.2	13.1

¹ External debt as a percentage of gross domestic product

² Debt-service as a percentage of exports of goods and services

³ Interest payments as a percentage of exports of goods and services

* Only interest payments on official debt

Source: International Monetary Fund, International Financial Statistics Yearbook 1990 (Washington, 1990); Organisation for Economic Cooperation and Development, Financing and External Debt of Developing Countries. 1989 Survey (Paris, 1990); The World Bank, World Tables, 1988-1989 Edition (Baltimore, London, 1989); Government of Papua New Guinea, Minister for Finance and Planning, Economic Policies, Vol. II, Statistical Appendix; authors' calculations.

Brazil (Population - 144.4 million, GDP - US\$ 324 billion, External debt - US\$ 112 billion, Exports US\$ 34 billion, Debt-service payments - US\$ 16,2 billion) had an external debt/GDP ratio of 34.8% (Papua New Guinea, 65.6%) and a debt-service ratio of 48% (Papua New Guinea, 38.5%). In comparison with Brazil's per capita income of US\$ 2,160 and Papua New Guinea's US\$ 810, per capita indebtedness in Brazil was US\$ 780 and in Papua New Guinea US\$ 633, with per capita debt-service payments of US\$ 112 for Brazil and US\$ 155 (!) for Papua New Guinea.

The World Bank calculates that Papua New Guinea's deficit on invisibles of US\$ 466 million in 1987 (1988: US\$ 565 million) will rise to US\$ 865 million by 1995. 'This is primarily due to increased dividend and interest payments on mineral sector investments. Another factor will be the increased freight and other costs associated with mineral sector imports'.⁸⁸ If this leads, as the World Bank believes, to Papua New Guinea being obliged to raise foreign loans of US\$ 4.5 billion between 1988 and 1992, then this will simply produce a further escalation in indebtedness. ('One-third of the total would be needed for amortisation payments, a reflection mainly of the substantial and rapid build-up of external public debt in the early-1980s, especially debt on commercial terms that is beginning to mature. Interest payments account for about 18% of the estimated financing needs').⁸⁹

Attempt of an appraisal

Any overall external assessment of the benefits and drawbacks of the model of development put into practice in Papua New Guinea must begin with the observation that since independence the fundamental democratic structures of the country have been secured and that few go hungry. Compared with other countries and regions, this is a major achievement. Agriculture still offers the majority of the population a reasonably tolerable life based on the still largely intact system of communal village ownership of land and subsistence production based on

small-holders, and occasionally 'cooperatives', or a mixture of subsistence and cash-crop farming.

However, it must be added that these achievements are seriously jeopardised by the centrifugal forces of the current model of development. The attempt at development via raw material production for the world-market must be viewed as having failed. Papua New Guinea has not moved closer towards meeting the developmental goals proclaimed on independence in 1976: in fact, they are now further out of reach.

The substantial growth in the production of mineral and agricultural raw materials for the world-market, primarily copper (copper concentrate), gold and wood (round timber), has brought Papua New Guinea, on balance, only meagre net returns and generated scarcely any 'developmental' side-effects, such as employment, transfer of technology and infrastructure.

A more serious reservation, however, is that the attempt to achieve development through raw material production for the world-market has generated a series of deleterious developments which threaten to increase in scale if the model continues to be pursued:

- Despite all rhetoric to the contrary, the priority accorded the raw material sector in the allocation of public resources for investment, infrastructure, supports etc. necessarily leads to the neglect of other important sectors, such as agriculture, exacerbating the tendency to regional and sectoral unbalanced development. Development potential in sectors which do not serve raw material extraction is left untapped and possibly irretrievably lost.
- Raw material production for the world-market, largely left to foreign companies, is frequently undertaken without proper attention to, and even with gross neglect of, the environment. Pollution, and often destruction, of the natural bases of life, such as forests, rivers and inshore waters, is reaching serious proportions.
- Not least as a consequence of the pollution and destruction to the environment, subsistence agriculture and mixed subsistence/cash-crop

production is under increasing pressure. More and more people are being forced to leave the rural sector and live under the threat of unemployment and poverty.

- Dependence on foreign capital, foreign technology and foreign management is growing rather than declining; reliance on imports of vital products, such as food, is also increasing.
- External indebtedness threatens to push the country into an irrecoverable crisis. Servicing the debts leaves little scope for forms of development directed at meeting local demand from local production, and which are both environmentally-prudent and socially defensible.

Of course, the problems outlined above are not solely attributable to the 'model' of development or exclusively the product of internal causes. Inherited structures and external factors, such as developments on world-markets, fluctuations in demand, and price-collapses have played their part. However, such factors have a more profound impact, the greater the degree of integration into the international economy through production for the world-market.

Popular responses to these increasingly serious developments vary between individual regions, depending on the resources that can be exploited which are at the disposal of the local people. Protest takes diverse forms, and is expressed not only in individual despair, migration and rascal activities but also in greater collective insistence on basic rights, for example by landowners, and demands for compensation payments which are 'ecologically' appropriate and 'economically' so high that projects are condemned to failure from the outset. Finally, protest is also expressed in passive resistance, blockades and other militant activities, extending to open rebellion.



Fly River, landing place Kiunga

Chapter VI

The Government and the World Bank programmes for economic stabilisation

In January 1990, the government announced a 'comprehensive set of economic measures to stabilise the economy'. The measures were particularly directed at countering the negative effects of three highly problematic developments: the shutdown of the Bougainville Copper mine, the fall in commodity prices, and finally the worryingly low level of national foreign currency reserves. The following concrete steps were decided to be undertaken:

- devaluation of the currency by 10%,
- cuts in public expenditure of Kina 80 million,
- a pay freeze (first and foremost in the public sector),
- a curtailment of credit growth to 4-5% a year.⁹⁰

This package bears a close and unmistakable resemblance to the familiar IMF and World Bank austerity programmes ('structural adjustment and stabilisation programmes'). In fact it signifies the advance fulfilment of the conditions set by these two institutions for the granting of new loan facilities. Just a few weeks later, the government agreed to a letter of intent with the IMF in line with these measures and in return received a promise of a stand-by and compensatory credit facility of Kina 82 million (US\$ 90.6 million). In addition, the World Bank approved a structural adjustment facility of US\$ 50 million.⁹¹

At a summit meeting of the 'Consultative Group of Donors' held in Singapore in May 1990, the government was also promised further loans totalling Kina 676 million (US\$ 710 million), payment of which, however, was made conditional on additional adjustment and stabilisation measures.

New measures were announced in the 1991 budget in January 1991: they included:-

- removal of import levies on 344 items,
- removal of import duties for capital-goods and raw materials for manufacturing industry, for seeds and breeding stocks, and on various chemicals (probably pesticides) and artificial fertilisers,
- lifting of all import bans,
- introduction of a 3% processing tax on the sale price of domestically produced products,
- increased taxes on cigarettes and alcoholic drinks,
- introduction of a 2% training levy on the payroll.⁹²

These and earlier measures, which are directed at a far-reaching liberalisation of the economy, the exposure of once relatively protected producers to international competition, the promotion of capital-intensive modernisation in export-orientated agriculture, cuts in direct corporate taxation and the switch to indirect taxes and levies consumption as a main

source of government revenue, represent a wholesale accommodation by the government to the economic (and developmental) policies advocated and prescribed by the IMF and World Bank. Sir Barry Holloway described this situation in unvarnished language:

*The facts of Budget 1990 are that we are being controlled by IMF and World Bank guidelines in our macro economic policies. If we do not follow those guidelines there is the so-called 'structural adjustment loan' of K 55m for the balance of payments assistance which will be in jeopardy. As well as this there is a 'Standby Facility' which would not become available to offset the budget deficit.*⁹³

Are these measures the right ones to overcome the consequences of the Bougainville crisis and offset the fall in the commodity prices for Papua New Guinea's agricultural exports, in line with their declared aim? Can devaluation, import liberalisation, credit controls, public spending cuts, raising indirect taxation and a pay freeze resolve the problem of employment, loss of income, declining demand and the evaporation of foreign currency earnings?

There are good grounds for fearing that the use of these measures is more likely to contribute to a worsening of these problems. The direct effects of the measures, and in particular public spending cuts, credit controls, raising taxes and levies on consumption, and freezing wages will be to reduce purchasing power and lower demand on the domestic market, producing stagnation and a decline in employment and in those economic activities oriented towards meeting local demand. The liberalisation of imports will have an additional negative impact on output and employment where these displace local production. Devaluation may seem to offer short-term advantages to agricultural exports, but at the same time will make servicing external debts more difficult.

It is evident that measures for structural adjustment are in essence the price which the government has been forced to pay, and was prepared to pay, in order to receive more loans which it wishes to use to

offset the direct consequences of the Bougainville crisis and the fall in commodity prices.

In the medium term, the government is hoping for an expansion in the production and export of mineral raw-materials. Finance Minister *Paul Pora* set out the government's view at a seminar held at the Institute for Applied Economic and Social Research in February 1990:

Mr. Pora said the policy measures were aimed at 'ensuring that the future of investments in mineral and oil developments of over three billion kina over the next five years will continue and help the economy to overcome the present crisis'.⁹⁴

In its previous planning, the government has assumed an external financing requirement of Kina 6.3 billion between 1989 and 1993. Some 75% of the projected need for external funds is deemed essential for financing projects in the mining sector.⁹⁵ These figures showing a disproportionate increase in investment in mining correspond with the views of the World Bank, whose recommendations assume an annual growth rate of 4.5% for mining compared with 2.7% for other sectors. The World Bank forecast a requirement of foreign capital and loans totalling US\$ 4.5 billion for the period 1998-1992, of which US\$ 2.6 billion would be needed for the mining sector.⁹⁶

Both the government and the World Bank plans of strategic decisions on economic development are directed primarily towards mining - notwithstanding their assurances on the future role and promotion of agriculture. Mining will absorb the vast bulk of, mostly private, investment resources and its development has led to the acceptance of a massive rise in external debt.

The assumptions of the World Bank as to the sources (grants, US\$ 1.130 billion; loans, US\$ 2.340 billion and direct investment, US\$ 1.047 billion) and application (current account deficit, US\$ 2.128 billion; interest payments, US\$ 814 million, amortisation US\$ 1.498 billion; currency

reserve US\$ 77 million)⁹⁷ of US\$ 4.5 billion external financing implies a net new foreign indebtedness (including foreign direct investment) of US\$ 1.9 billion. This would raise Papua New Guinea's external indebtedness to US\$ 4.5 billion by 1992. Annual interest payments alone would require the yearly export earnings of a mine the size of Ok Tedi or four times existing annual receipts from timber exports.

However, the World Bank does not appear to be entirely at ease at this prospect and, as the following conclusion to its recommendations illustrates, prudently backs away from any responsibility:

*Nevertheless, with careful economic management, Papua New Guinea is well placed to lay the foundations for stronger and broad-based growth while maintaining a viable external position, and to exploit the opportunities for accelerated growth, should prospects for substantial earnings from mineral, and possibly petroleum, exports materialize in the 1990s.*⁹⁸

This would not be the first time that the World Bank has fundamentally erred as to the effects of its economic recommendations and forecasts. The contrast, set out below, between the forecast and actual movement of Papua New Guinea's external public debt speaks for itself (even if the figures were to be adjusted for inflation).

	Public external debt							
	(Kina millions)							
	1981	1982	1983	1984	1985	1986	1987	1988
Projected change ¹	629	601	565	523	483	419	365	319
Actual change ²	639	768	956	1011	1098	1239	1471	1434

- 1 The World Bank, Papua New Guinea, Selected Development Issues (Washington, 1982), p. 76.
- 2 The World Bank, World Tables, 1988-89 Edition (Baltimore, London, 1989), p. 459; Bank of Papua New Guinea, Quarterly Economic Bulletin (September, 1990), p. 28.

It is much more probable that the mistakes of the 1980s, which culminated in the current crisis, will not only continue into the 1990s but are also likely to be compounded. A programme of economic liberalisation and expansion of production for the world-market will not only fail to redress structurally-rooted regional and sectoral imbalances, unequal income distribution, unemployment, external debt and the destruction of the physical environment, but will sustain these tendencies.

And it is also likely that the state's finances will only benefit to a very small degree from the earnings of projects which have either just come onstream, or will shortly begin, such as Misima, Porgera, Lihir, and Kutubu, on which the government has pinned its hopes for surmounting the present crisis. The bulk will flow abroad to meet debt-service obligations. The alarm-bells ought to have begun ringing when the World Bank in 1988 forecast a need for external financing (loans) of US\$ 2.3 billion simply to cover current debt-service for the period 1988-1992. There are grounds for fearing that the implementation of the government and the World Bank programmes for economic stabilisation and sustained economic growth will deny the country any room to manoeuvre. As a consequence, meeting debt-service obligations will overshadow all other economic and environmental considerations. Even in the unlikely event that this policy does not lead to economic disaster, the economy and society, and the people and the natural environment of Papua New Guinea will be subjected to a high degree of external control - without any realistic prospect of being able to check the predictable ensuing ecological, cultural and social havoc.

Chapter VII

Prospects for socially useful and ecologically sustainable development

The Constitution of Papua New Guinea sets out a clearly-defined economic and developmental mission and an unambiguous injunction to respect the environment.

The economic and developmental mission reads as follows:

National sovereignty and self-reliance

We declare our third goal to be for Papua New Guinea to be politically and economically independent and our economy basically self-reliant.

1. Our leaders to be committed to these national goals and directive principles to ensure that their freedom to make decisions is not restricted by obligations to or relationship with others, and to make all of their decisions in the national interest.

2. All governmental bodies to base their planning for political, economic and social development on these goals and principles.
3. Internal interdependence and solidarity among citizens and between provinces to be actively promoted.
4. Citizens and governmental bodies to have control of the bulk of economic enterprise and productions.
5. Strict control of foreign investment capital and wise assessment of foreign ideas and values, so that these will be subordinate to the goal of national sovereignty and self-reliance, and in particular for the entry of foreign capital to be geared to national social and economic policies and to the integrity of the nation and the people.
6. The state to take effective measures to control and actively participate in the national economy and in particular to control major enterprises engaged in the exploitation of natural resources.
7. Economic development to take place primarily by the use of skills and resources available in the country either from citizens or the state and not in dependence on imported skills and resources.
8. The constant recognition of our sovereignty which must not be undermined by dependence on foreign assistance of any sort, and in particular for no investment, military or foreign-aid agreement or understanding to be entered into that endangers our self-reliance and self-respect, or our commitment to these national goals and directive principles, or that may lead to substantial dependence upon or influence by any country, investor, lender or donor.⁹⁹

The environmental task set by the Constitution is very clear.

Papua New Guinea's natural resources and environment to be conserved and used for the collective benefit of us all, and be replenished for the benefit of future generations.

(Papua New Guinea is one of the first, and one of the few, countries in which the protection of the environment is constitutionally anchored)

1. Wise use to be made of our natural resources and the environment in and on the land or seabed, in the sea, under the land, and in the air, in the interests of our development and in trust for future generations.

2. The conservation and replenishment, for the benefit of ourselves and posterity, of the environment and its sacred, scenic, and historical qualities.
3. All necessary steps to be taken to give adequate protection to our valued birds, animals, fish, insects, plants and trees.¹⁰⁰

How can these constitutional goals be realised? What needs to be done to ensure that the process of development moves in the direction set out in the goals of development proclaimed in 1976 (see Chapter I), and not in the opposite direction?

From an analysis of development to date, its determinants and results, it is relatively easy to deduce what must not happen in the future and what, therefore, needs to be prevented:

- A stop must be put to the destruction of the natural foundations of life wreaked by the exploitation of mineral resources and felling of tropical rain-forest in a manner which either neglects or runs contrary to social and environmental considerations.
- A check must be placed on the supplanting of subsistence/cash-crop mixed farming. This would require the cessation of forms of raw-material production and felling of the rain-forest which are harmful to the environment and a stop to the conversion of land in communal ownership into alienable property.
- It is imperative that further growth in external indebtedness is averted ('let credit be national' - *J. M. Keynes*).
- The state should renounce further withdrawal from the economy (liberalisation), and hence from any responsibility for economic, social and environmental development.

A number of points can be identified which would contribute towards meeting the constitutional goals of self-reliant and independent development in accord with the preservation of the environment. However, our intention here is not to outline an alternative model of development to that currently being practised. Aside from the fact that it would be unrealistic to expect that **models** as such might be implemented, such a

task should not be attempted 'from the outside'. What can be done is to indicate the steps and strategic decisions necessary for a form of economic and environmental development in Papua New Guinea which is valid under current conditions, in accord with the constitution, and which would move the country closer to its declared developmental aims.

- Strict environmental conditions must be imposed on current and planned mining projects (especially gold and copper mining and processing) to ensure that no enduring and irreversible damage takes place during the extraction of mineral resources. The suspension of both important environmental protection laws, the Environmental Planning Act and the Environmental Contaminants Act for the mining sector¹⁰¹ must be reversed immediately. If environmental standards cannot be complied with or are breached, either on technical or operational grounds, then the activities concerned must cease.
- Given the large number of extractive, developmental and exploratory activities currently underway in mining, the ability to be able to assess, decide, and act on a reliable basis of information and an accurate overall picture of operational practices, economic relevance and the environmental impact of projects requires the urgent establishment of a report prepared by a government commission (comparable with the Barnett Commission).
- The time has come for at least a proportion of raw-materials, especially oil and gold, to be produced on local account instead of by foreign companies exclusively for foreign account. It would be advisable for some raw-material production, primarily oil, to be mainly limited as required to meet local demand with no unlimited export (reserves could be exhausted more quickly than would be desirable for the interests of future generations).
- In order to secure an appropriate participation by the state in the receipts from the production and sale (export) of mineral raw-materials - Papua New Guinea's natural riches - in addition to taxation of earnings appropriate levies should be imposed on output volumes of ore, oil etc. This would ensure that receipts would flow to the public budget from raw-material production - from the exploitation of natural resources - irrespective of the profitability of production (either actual or declared).

- In agriculture, it is necessary to conserve, support and promote that form of production which has proved itself to be both economically and ecologically superior under current conditions - namely, subsistence cash-crop mixed farming. The detailed measures are well-known: extending infrastructure, especially transport, together with facilities for storage, warehousing, and marketing; protection against (possibly subsidised) agricultural imports which displace local products; and primarily the preservation of traditional forms of landownership and land-use. Common ownership (village or clan) of the land combined with the temporary cession (on average 15 years) of land to village- or clan-members for individual or communal use has shown itself to be an appropriate form of ownership and land-usage under current conditions, and hence both economically efficient and environmentally sound. (It is worth noting, for example, that the United Nations Economic Commission for Asia and the Pacific Region regards 'communal' landownership in the Pacific Region as a valuable starting-point for the economic restructuring of the region.)¹⁰²
- An immediate stop must be put to the malpractices in the 'timber industry' uncovered by the Barnett Commission. Felling concessions, most of which were acquired unlawfully as the Barnett Commission found, must be taken away from the logging companies. Round-timber exports should be forbidden and the illegal felling and export of timber prevented. The natural wealth of the rain-forest can be used in other, and more beneficial ways without entailing its simultaneous destruction. As studies of rain-forest regions in Latin America have shown, the forest's potential can be efficiently tapped by gathering (see footnote 61). The gathering of the 'wild fruits' of the rain-forest - rattan, resins, latex, aromatics, spices, perfumes, shellac, ethereous oils, disinfectants, insecticides, herbicides, fibres, adhesives, natural dyes, tanning agents, fats, wax, medicinal herbs, building materials, firewood, fruits, fish and game - could replace many imports and provide an enduring source of exports and export earnings. The genetic pool constituted by the rain-forest could even become one of the country's most important sources of income.
- Products obtained by gathering from the rain-forest could provide the basis for the development of an, as yet, only rudimentary, manufacturing industry. Efficient small and medium sized establishments, quite possibly internationally competitive, could produce foods, pharmaceutical products, dyes, furniture, building materials etc. State support, for

example through the promotion of training and consultancy, loans, protection (especially during the early phase of development of local undertakings) could achieve a good deal.

- The planned extension of infrastructure in all important areas - health, education and training, transport and communication, public utilities, waste disposal facilities - which has often been invoked but as yet not pursued with any determination could simultaneously achieve a number of important objectives by triggering a series of desirable developments. An efficient infrastructure would promote better integration of rural and urban development; it would make it easier to supply the local market with domestically-produced goods (and hence contribute to reducing import-dependency); it would provide the foundations for the development of a diversity of other economic activities and, last but not least, would have direct and indirect employment effects. The 1988 Public Investment Programme certainly represented a step in the right direction, but has now become a victim of the crisis. The recent announcement of a capital works programme to create 30,000 jobs might represent a breakthrough in this respect.
- Targeted measures to create employment, offer incomes and housing in the public sector (e.g. through infrastructural investment, and public or state-supported housebuilding) and in the private sector (e.g. through the promotion of gathering, manufacturing and marketing facilities) are also a precondition for combating the roots of criminal and rascal activities - namely, unemployment, poverty and homelessness.
- External indebtedness **must** be reduced. Once foreign debt reaches a scale at which annual 'economic surpluses' no longer suffice to cover debt-service payments, there is virtually no escape from the 'debt trap' as unpaid interest payments and repayments of principal are simply added to existing debt. Papua New Guinea is not far from this point. As the example of many other countries has shown, such a situation would rob the government of any room to manoeuvre and the country would be in the grips of the creditor banks and nations, ending any aspirations of national independence, sovereignty and self-reliance. The reduction in external independence could be achieved in the first instance through the imposition of duties and levies on imports, and through imposing or increasing royalties on raw-material production, with the receipts devoted to debt-service. Naturally, this would have to take place

on the precondition that in the future there would be no resorting to dubious large-scale projects financed by foreign loans.

- Finally, such measures and strategic decisions presuppose that the government does not withdraw from the economic process, as appeared possible a year ago, but rather, in a situation of crisis, is willing and determined to exercise its constitutional mission of building an economy based as much as possible on self-reliance and conservation of the environment.

It might be objected that such proposals are unrealistic because they could not be implemented in the face of the interests of the mining companies, logging companies, oil companies, banks, landowners and other influential local and foreign groups. Our counter-argument would be that the role of such proposals is principally to point out the direction in which true and realistic policies would have to proceed.

The conditions for the implementation of policies rooted in the economic and environmental tasks set out in Papua New Guinea's constitution are by no means inauspicious. Democratic structures are still intact, even if under threat from corruption, foreign dependency, rascal activities, secessionism, and curtailments of civil liberties (curfews). The country still has control over a large measure of economic independence, mainly by virtue of the fact that 85% of the population is still able to provide for itself through subsistence production. The rain-forest is still largely undamaged and environmental problems are still within bounds. It can still make good use of its natural riches provided it does not turn them over to unlimited exploitation which ignores social and environmental considerations. In order to do this special conditions must be placed with regard to the extraction of natural resources. These conditions should include the protection of the environment and whether the projects are of enduring benefit to the economic and social development of the country. The demand for the raw-materials over which Papua New Guinea has no control is growing. Such control would render the extraction of natural resources a blessing rather than a curse for the country.



A village at the Fly river, south of Kiunga

Appendices

Appendix 1

Permitted limits for chemical matter (milligram per litre, mg/l)

Parameter	Maximum limit	Action threshold	Minimum quality
	A	B	C
Aluminium	0.2	-	
Ammonium	0.5	-	1.3
Arsenic.....	0.01.....	0.05	
Barium		0.01	
Lead.....	0.04.....	0.05	
Cadmium.....	0.005.....	0.005	
Chrome	0.05		0.07
Cyanide.....	0.05.....	0.05	
Iron	0.2	0.3 dis.	2.0
Copper.....	0.1.....	0.05.....	0.05
Manganese	0.05		
Nickel	0.05		0.05
Nitrate	50		50
Nitrite	0.1		
Phosphorus			0.4
Mercury	0.001	0.001	
Zinc	0.1	3	1

A = Federal German drinking water maximum prescribed limit

B = European Community Directive on Quality Requirements for Surface Waters for Obtaining Drinking Water (Treatment Category A1)

C = Federal German minimum quality requirements for running waters (water quality category II/III)

Water quality criteria for cyprinidae (carp)

(from Bohl, Zucht und Produktion von SGwasserfischen, DLG-Verlag, Frankfurt/1982)

Parameter	Value/Concentration
Temp.	16-26 C
pH	6.5-8.5
Hardness	> 25 CaCO ₃ mg/l

	CaCO ₃ mg/l				
	10	50	100	300	500
Copper (dis.) mg/l	0.005	0.022	0.04	0.112	
Zinc (tot. sat.) mg/l	0.3	0.7	1.0	-	2.0
Cadmium		0.004	0.012		

Nickel	mg/l	0.5
Cobalt	mg/l	0.1
Manganese	mg/l	0.1
Lead	mg/l	0.1
Arsenic	mg/l	0.01
Iron	mg/l	0.9
Turbidity	FTU	>25

Appendix 2

Sample	Running water										Sea water				Waste
	6	7	20	21	31	32	40	41	42	50	51	10	11	2	
Cond. uS/cm	171.4	249	112.8	109.8	112.2	122.7	28.3	124.4	169.6	206	226	38600	38900	467	
Temp. Deg. C	20.3	21.5	24.1	21.1	24.7	24.2	24.5	23.3	22.5	20.4	21.6	26.6	26.6	28.6	
pH	8.39	8.18	7.54	7.84	8.41	8.27	6.98	8.46	8.30	8.49	8.26	8.36	8.38	7.48	
Turbid. FTU	150	246	5.3	7.0	52.2	30.9	3.9	182	215	4.3	151.5	4.6	25.9		
Hardness CaCO3 mg/l			59	57	53.4	55	18	66	82	110	114				
Cyan. (free) mg/l	0.053	0.133	0.002	<0.001	0.002	<0.001	0.001	0.001	<<0.001	0.001	<0.005	<0.005	<0.005	<0.005	
Arsenic mg/l	<0.0005	<0.0005	<0.0005	<0.0005	0.009	0.009	0.002	0.052	0.042	0.001	0.032	<0.01	<0.01	0.003	
Mercury mg/l	1.67	5.10	0.008	0.012	0.457	0.328	<0.001	2.16	2.34	0.007	2.11	<0.05	<0.05	5.5	
Copper mg/l	0.371	0.691	0.002	0.004	0.083	0.080	0.003	0.342	0.313	<0.001	0.255	0.011	0.014	<0.1	
Lead mg/l	1.02	1.57	0.007	0.015	0.166	0.107	0.012	0.723	0.734	0.005	0.561	0.05	0.05	0.38	
Zinc mg/l	0.0040	0.0080	<0.0005	<0.0005	<0.0005	<0.0005	0.0035	0.0030	<0.0005	0.0025	0.0015	0.0015	<0.0015	<0.005	
Cadmium mg/l	66.7	140	1.71	1.82	14.1	10.1	0.85	71.6	70.8	0.72	50.8	1.18	7.48		
Iron mg/l	7	11	7	12	8.4	6.6									
Sodium mg/l	7	17	0.8	1	3.5	2									
Potassium mg/l	21	46	1.5	1.7	5.5	3.7									
Magnesium mg/l	310	870	19.4	21	66	49									
Calcium mg/l	33	82		1											
Aluminium mg/l															

Appendix 3

Gross investment in plant and equipment was as follows between 1983 and 1988:

	Gross investment in plant and equipment	
	at current prices	at 1983 prices
1983	643.1	643.1
1984	476.0	450.0
1985	413.0	366.4
1986	570.7	461.8
1987	517.1	412.9
1988	611.5	449.4
1989*	873.8	628.8

* provisional figures

Source: Bank of Papua New Guinea, Quarterly Economic Bulletin, September 1990.

Appendix 4

Between 1983 and 1989, Papua New Guinea's public finances developed as follows:

Central Government Budget							
(Kina millions)							
	1983	1984	1985	1986	1987	1988	1989*
Revenue	624	707	729	742	840	849	966
Local receipts	411	474	512	537	656	659	776
Foreign grants	213	233	217	205	184	190	190
Expenditure	785	917	864	920	972	1082	1165
Provinces	200	215	225	221	234	242	262
Debt-service	139	237	167	169	188	253	238
Interest	71	164	96	85	110	168	154
Principal	68	73	71	84	78	85	84
Borrowing	161	210	135	178	132	232	199
from abroad	135	76	50	98	83	68	107

* estimate

Source: Government of Papua New Guinea, Minister for Finance and Planning, Economic Policies, Vol. II, Statistical Appendix

Appendix 5

Additions to the Mineral Resources Stabilisation Fund and withdrawals from the fund, which accrue to the central government budget as revenues (total receipts from mining activities), changed as follows between 1981 and 1987:

Mineral Resources Stabilisation Fund (MRSF)							
(Kina millions)							
	1981	1982	1983	1984	1985	1986	1987
Receipts from							
Bougainville and	68.8	23.2	22.5	52.1	20.2	30.3	21.6
Ok Tedi							
Taxes	58.1	20.9	16.8	44.5	17.2	23.4	11.5
Dividends	10.7	2.3	5.7	7.6	3.0	6.9	10.1
Receipts from							
MRSF capital	2.4	2.5	2.5	3.4	3.5	5.3	4.1
reserves							
Total revenues	71.2	25.7	25.0	55.5	23.7	35.6	25.7
(from Ok Tedi)	0.0	0.0	0.0	0.0	0.0	0.0	7.8
Central govt.							
withdrawals	81.4	40.0	21.0	29.7	32.1	14.0	60.5
Balance	-10.2	-14.3	4.0	25.8	-8.4	21.6	-34.8
Fund assets	46.0	31.8	35.8	61.7	53.7	75.3	40.8

Source: The World Bank, Policies and Prospects for Sustained and Broad-Based Economic Growth, Vol. I, p. 111.

Appendix 6

Samples

No.	Date	Time	Location
6	18.8.90	15:00	Ok Tedi, 10km N. Tabubil
7	18.8.90	16:00	Ok Tedi 6km S. Tabubil
20	12.8.90	15:30	Fly/Kiunga 6km upstream
21	12.8.90	16:00	Fly/Kiunga 2km downstream
31	13.8.90	11:00	Ok Tedi 3km N. D'Albertis Junc.
32	13.8.90	11:30	Fly 5km N. Kiunga
40	15.8.90	09:30	Ok Mart 36km N. Kiunga
41	15.8.90	11:30	Ok Tedi S. Ningerum
42	15.8.90	12:30	Ok Tedi 15km N. Ningerum
50	17.8.90	10:30	Ok Menga 119km N. Kiunga
51	17.8.90	11:00	Ok Tedi 125km N. Kiunga
10	9.8.90	16:00	Fly delta 8° 28' S. 143° 52' E. Depth 11m
11	9.8.90	16:30	Fly delta 8° 26.55' E. 143° 48' E. Depth 4m
2	12.8.90	16:30	Kiunga harbour effluent

Appendix 7

United Nations, Economic and Social Commission for Asia and the Pacific, Economic and Social Survey of Asia and the Pacific 1989. Bangkok 1990.

'Communal' land tenure system: an institutional factor in economic restructuring in the Pacific

One of the most striking aspects of the economic development and transformation in the Pacific, particularly in the larger islands, relates to the large-scale, indigenous participation in commercial agriculture. Among other facilitating factors, this implies a certain level of productive surplus within the subsistence sector, and this is well portrayed in a widely quoted description by *Professor E. K. Fisk*:

"Except in the atolls and one or two smaller territories whose populations have outgrown their land areas, . . . land is still available to most of the self-subsistent indigenous peasants of the Pacific in relative abundance, and many of them live in a state of what I have called (subsistence) affluence. This means that they are able to produce from their own resources as much as they can consume of the normal staple foods that they are used to, together with a reasonable surplus for entertainment, display and emergency, and a standard of housing, clothing, and entertainment requisites . . . that is traditionally acceptable, with the employment of a relatively small part of the total potential resources of labor and land available to them. This means that within their self-subsistent, non-monetary production system the productivity of their labor is very high, and it is quite common in these regions to find substantial groups of peasants able to sustain this level of consumption from their own resources at the cost of an average labor input of about three hours per man-day or less.**" (Footnotes* and ** omitted and the bracketed word inscripted).^a*

At the same time, land abundance and the significant amount of surplus resources to which it gave rise substantially reduced the need for additional investment to the government in agriculture and instead

provided considerable support to the mobilisation of domestic resources for public capital formation. The traditional land tenure and ownership system, which was significantly different from that of the Western world, explains this distinctive role of Pacific agriculture.

The tenure system in the Pacific evolved essentially to accommodate subsistence agriculture.^b Rights to land in most cases are vested in groups (for example, extended family, lineages, clans, tribes and so on), and for any one piece of land there exists a hierarchy of rights at several levels. Land rights are retained not by inheritance alone but also by residence and active participation in the local community; they will weaken or wither away for those absent for too long. The sale of land was traditionally unknown in most Pacific islands and is still forbidden by law in many of them.

The attachment to land has very deep social, cultural and economic roots in the Pacific island subregion; it is well expressed by *Professor C. D. Rowley*:

"The New Guinea villager shares with most others that special attachment to the land characteristic of those whose land rights are their hold on life itself. These rights are based on the tradition of inheritance, which may be matrilineal or patrilineal. The ancestral spirits may help him to guard the land; at times, jealous of the living, they may interfere with his enjoyment of it, and their attitudes may need to be controlled through proper ritual. Before the European came, there was no concept of individual ownership, nor of land as a commodity. Land belongs to the whole group, and the villager's rights are those of user only. This relationship involves the most deep-seated emotions, and is different from that of the owner to his personal property. No right of a person to dispose of land was recognised; for the ancestral spirits must have their place, and the unborn generations must be provided for."^c

Any scheme for modernisation and development of the Pacific island subregion which does not sufficiently take into account the basic institutional factor of the land tenure system is likely to prove unrealistic.

Notes for Appendix 7

- a. Cited in N.V. Lam, "A note on the nature and extent of subsistence surplus in Papua New Guinea." *Pacific Viewpoint*, Vol. 23, No. 2 (October 1982), p. 174.
- b. The following discussion draws heavily from R. Crocombe, *The South Pacific - An Introduction* (Suva, University of the South Pacific, 1989), pp. 105-118; see also the references quoted therein.
- c. *The New Guinea Villager - A Retrospect from 1964* (Sydney, F.W. Cheshire, 1965), p. 115.

Footnotes

1. Cf. Papua New Guinea Government White Paper, *The Post-Independence National Development Strategy* (Port Moresby, 1976).
2. See, Department of External Territories, *Investing in Papua New Guinea* (Canberra, 1968).
3. See, for example, The World Bank, *Papua New Guinea, Its Economic Situation and Prospects for Development* (Washington, 1978); *idem.*, *Papua New Guinea, Selected Developmental Issues* (Washington, 1982); *idem.*, *Papua New Guinea, Policies and Prospects for Sustained and Broad-Based Growth* (Washington, 1988).
4. Galeva Kwarara, *The National Development Strategy and Development Issues for the 1990s*, in P.A.S. Dahanayake (ed.), *Post-Independence Economic Development of Papua New Guinea* (Boroko, 1982), p. 26.
5. The World Bank, *Papua New Guinea, Its Economic Situation and Prospects for Development* (Washington, 1978), p. 69. (According to the World Bank, an 'enclave project' is 'any very large foreign-owned project involved in exploitation of natural resources'.)
6. The World Bank, *op.cit.*, p. 8.
7. The World Bank, *Papua New Guinea, Selected Development Issues* (Washington, 1982), pp. 6-7.
8. See, Ciaran O'Faircheallaigh, 'The Economic Impact of the Bougainville Copper Project', in Akilagpa Sawyerr, *Economic Development and Trade in Papua New Guinea. Proceedings of the Fourteenth Waigani Seminar 1981* (University of Papua New Guinea, 1984), pp. 107-25.
9. Richard Jackson, *Ok Tedi: The Pot of Gold* (Boroko, 1982), p. 107.
10. See, *Mining, Annual Review 1990*, p. 81.
11. See, *Post-Courier*, 11 October 1990.
12. *The Times of Papua New Guinea*, 22 November 1990.
13. See, *The World Bank, Papua New Guinea, Policies and Prospects for Sustained and Broad-Based Growth* (Washington, 1988), Volume II, p. 17.

The Annual Report of the Bank of Papua New Guinea for 1988 notes: 'The increase in visible receipts was more than offset by an increase of 22% in invisible payments from

K553 million in 1987 to K675 million in 1988. This reflected an increase in dividend payments by BCL and other companies and large debt payments by the government and Ok Tedi' (Bank of Papua New Guinea, Report and Financial Statements for the year ending 31 December 1988, p. 18).

14. See, Ok Tedi News Magazine, 1 (1990), p. 13.
15. See, Richard Jackson, *op.cit.*, p. 177.
16. See, Ok Tedi News Magazine, 1 (1990), p. 13.
17. See, Ok Tedi Update, 4 (1990), p. 3.
18. See, The World Bank, Papua New Guinea. Policies and Prospects for Sustained and Broad-Based Growth (Washington, 1988), Volume I, p. 111.
19. See, Richard Jackson, *op.cit.*, pp. 148-149. 'The main hope of the government is that Ok Tedi will support government budgets. . . . The government will obtain its share in several ways, primarily through taxation and its dividends as a 20 per cent shareholder. Through the latter it is expected to receive US\$470 million over the life of the mine. Taxation includes a 35 per cent company tax during the investment recovery period of the project, and a 36.5 per cent company tax (or whatever tax is generally applicable within Papua New Guinea). this should bring in US\$2,000 million. On company earnings in excess of either a 20 per cent discounted rate of return on investment or that figure equal to the prevailing prime corporate lending rate plus 10 per cent, it will receive 70 per cent in taxes, through the additional profits tax (or resource rental tax). This should bring in close to US\$900 million. On all dividends paid overseas, a 15 per cent withholding tax will be levied. Employees' earnings will be taxed in the normal way, some import duties will be collected. In all, the government hopes to collect between three and four billion dollars - depending on market prices. It looks therefore as if Ok Tedi will do what is expected of it for government revenues.'
20. See, Minister of Finance and Planning, 1990 Estimates of Revenue and Expenditure, p. XVII.
21. See, Ok Tedi Update, 4 (1990), p. 3.
22. Cf. Richard Jackson, *op.cit.*, p. 177.
23. The company expects receipts of Kina 500 million in 1990, and puts the net foreign currency earnings accruing to the state at some Kina 100 million.
24. See, Ok Tedi Mining Limited, Ok Tedi: An Example of Modern Environment Impact Assessment (June, 1988), p. 5.
25. Company figures for 1987.
26. Ok Tedi Mining Limited, Ok Tedi: An Example of Modern Environmental Impact Assessment (June, 1988), pp. 5 and 8.
27. Ok Tedi Update, 4 (1990), p. 4.
28. Cf. J. H. Reichholf, *Der unersetzbare Dschungel* (Munich, 1990).
29. See, Ok Tedi Environmental Study, 1 Main Report, pp. 30-37 (June, 1982), Volume 2, pp. 79-114.
30. H. Sioli (ed.), *The Amazon* (Dordrecht, 1984).

31. See, Encyclopaedia Britannica, Vol. 17 (Chicago, 1985), p. 1030.
32. See, Appendix 2, Ok Tedi Environmental Study, Vol. 2, pp. 92-94, (1982).
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36. J. H. Reichholf, *Der unersetzbare Dschungel* (Munich, 1990).
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38. D'Albertis, *New Guinea: What I did and what I saw* (London, 1880), Vol. 2, p. 285.
39. See, *Supplem. Environm. Invest.*, 1989, Vol. 2, Fig. 4.
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41. See, W. Salomons, U. Foerstner (eds.), *Chemistry and Biology of Solid Waste*, (Heidelberg, 1988) p. 48.
42. *Financial Times*, 16 August 1990.
43. Umweltbundesamt, *Daten zur Umwelt 1988/89* (Berlin, 1989); Commission of the European Communities, *Die Lage der Umwelt in der Europaischen Gemeinschaft 1986* (Luxemburg, 1986).
44. *New Scientist*, 18 November 1989, p. 19.
45. The World Bank, *Papua New Guinea, Policies and Prospects for Sustained and Broad-Based Growth* (Washington, 1988). p. 65.
46. The World Bank, *Papua New Guinea, Policies and Prospects for Sustained and Broad-Based Growth, Volume II* (Washington, 1988), p. 24.
47. Cf., Rolf Obertreis, *Papua-Neuguinea: Die Zeitbombe im Fly River*, in, *epd-Entwicklungspolitik*, 19/20 (1989), p. 24.
48. Roger J. Higgins, *Environmental Management of New Mining Operations*, in, Wim Salomons, Ulrich Foerstner (eds.), *Environmental Management of Solid Waste. Dredged Material and Mine Tailings* (Heidelberg, 1988), pp. 379, 380, 381 and 386 (emphasis, Starnberg Institute).
49. International Monetary Fund, *International Financial Statistics Yearbook 1990* (Washington, 1990), p. 575 (1988: 1 Kina = US\$1.15).
50. The World Bank, *World Development Report 1990* (Oxford, New York, 1990), p. 178; The World Bank, *World Tables, 1988-1989* (Washington, 1989), p. 457.
51. United Nations Conference on Trade and Development, *Handbook of International Trade and Development Statistics* (New York, 1990), pp. 434-5.
52. United Nations Conference on Trade and Development, op.cit., p. 450.
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54. Bank of Papua New Guinea, Quarterly Economic Bulletin, September 1990, pp. 5 and 2.
 55. The World Bank, World Development Report (Washington, 1990), p. 192.
 56. The World Bank, Papua New Guinea. Policies and Prospects for Sustained and Broad-Based Economic Growth, Vol. II (Washington, 1988), pp. 38-9.
 57. The World Bank, Papua New Guinea. Selected Development Issues (Washington, 1982), pp. 121 and 138; idem., Policies and Prospects for Sustained Economic Growth, Vol. II, pp. 54-55; Government of Papua New Guinea, Minister for Finance and Planning, Economic Policies, Vol. II, (1989).
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 68. The Barnett Commission observed: 'It would be fair to say, of some of the companies, that they are now roaming the countryside with the self-assurance of robber barons, bribing politicians and leaders, creating social disharmony and ignoring laws in order to gain access to, rip out, and export the last remnants of the province's valuable timber. These companies are fooling the landowners and making use of corrupt, gullible, and unthinking politicians. It downgrades Papua New Guinea's sovereign status that such rapacious foreign exploitation has been allowed to continue with such devastating effects to the social and physical environment, and with so few positive benefits. It is doubly outrageous that these foreign companies . . . have then transferred offshore secret and illegal funds . . . at the expense of the landowners and the PNG Government.'
- (Commission of Inquiry Interim Report No. 4, Vol. 1, p. 85, 'New Ireland', quoted from, Asia-Pacific Action Group, The Barnett Report. A Summary of the Report of the Commission of Inquiry into Aspects of the Timber Industry in Papua New Guinea.)

69. Cf. Australien-Neuseeland-Suedpazifik-Verein e.V., Rundschreiben 4 (1989), Papua-Neuguinea, p. 11.
70. The Times of Papua New Guinea, 3 January 1991.
71. Cf. Federal Statistical Office, Laenderbericht Papua-Neuguinea (Stuttgart, 1990), p. 40.
72. See, Mining Journal Limited, Mining Annual Review (London, 1990), p. 81.
73. See, Mining Journal Limited, op.cit., p. 82.
74. The World Bank, Papua New Guinea, Policies and Prospects for Sustained and Broad-Based Economic Growth, Vol. II, p. 16.
75. Economist Intelligence Unit, Threats to Copper Supply. A Political Risk Analysis (London, 1990), p. 71.
76. Financial Times, 3 April 1989.
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78. See, Post-Courier, 30 August 1990, Supplement Porgera Gold, p. 24.
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81. The Times of Papua New Guinea, 21 February 1991, p. 10.
82. Cf. Government of Papua New Guinea, Minister for Finance and Planning, Budget Speech, 7 November 1990, pp. 20-1, 33 and 38.
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86. International Monetary Fund, World Economic Outlook (Washington, 1990), p. 180.
87. Cf. International Monetary Fund, op.cit., pp. 181 and 182.
88. The World Bank, Papua New Guinea, Policies and Prospects for Sustained and Broad-Based Economic Growth, Vol. I, p. 76.
89. The World Bank, op.cit., p. 78.
90. Cf. Bank of Papua New Guinea, Quarterly Economic Bulletin (March, 1990), p. 2.
91. Cf. Financial Times, 20 February 1990; Nachrichten fur AuBenhandel, 9 July 1990.
92. Cf. Nachrichten fur AuBenhandel, 8 February 1991.
93. The Times of Papua New Guinea, 8 November 1990.
94. International Herald Tribune, 17/18 Februar 1990.
95. Cf. Government of Papua New Guinea, Minister for Finance and Planning, Economic Policies, Vol. II, p. 9.

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99. Independent State of Papua New Guinea, Papua New Guinea Constitution, Part III, Basic Principles of Government, Division I, National Goals and directive Principles.
100. Ibid.
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